CONCEPTUAL SITE MODEL

Hess Corporation – Former Port Reading Complex (HC-PR)

750 Cliff Road, Port Reading, Middlesex County, New Jersey
NJDEP SRP PI # 006148
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SITE NARRATIVE

The Hess Corporation former Port Reading Complex (Site) is a former hydrocarbon refinery located on a ±223-acre irregularly shaped parcel located in Port Reading, New Jersey that is situated between Cliff Road to the north, the Arthur Kill to the south, the Conrail Port Reading Rail Yard to the east, and a Public Service and Enterprise Group (PSE&G) power generating station to the west. The northern portion of the Site is situated on glacial till and the central and southern areas of the Site are situated on historic fill overlying an estuarine and salt marsh (Meadow Mat) deposit. The Site topography gently slopes towards the Arthur Kill at a gradient of 2.3×10^{-3} feet per foot (ft/ft). Horizontal groundwater gradients are equally as unremarkable as the topography with calculated gradients are also in the range of 2×10^{-3} feet per foot (ft/ft) and also dipping towards the Arthur Kill. These relatively flat horizontal gradients translate to low groundwater seepage velocities generally measured in dimensions of scale of 15 to 30 feet per year in the unconfined shallow water bearing zone.

There are three water bearing units beneath the Site that have been evaluated and they are (1) a shallow unconfined zone, (2) an intermediate semi-confined zone, and (3) a deep confined zone. Groundwater recharge to these water bearing units comes primarily from lateral groundwater flow from upgradient sources. Groundwater recharge and discharge occurs intermittently to and from the adjacent and on-Site wetland areas and an on-Site detention basin. Groundwater discharge occurs continuously to the tidally influenced Arthur Kill. There is also an infilled stream that once cut across the central area of the Site that appears to have no influence on groundwater flow directions and monitoring data indicates it does not serve as a preferential pathway for contaminant migration. There is a bulkhead composed of interlocking steel sheet piles driven to an elevation of -42 ft-mean sea level (msl) and positioned along the southern property boundary at the Arthur Kill. Over the operational history of the refinery since 1958, the presence of this bulkhead structure appears to attenuate groundwater flow and contribute to a groundwater stagnation zone observed in the central and southern areas of the Site where groundwater gradients and flow rates become small.

The industrial use of the Site has resulted in localized spills and releases throughout its history. These spills and releases have resulted in 117 documented potential Areas of Concern (AOCs) that include the presence of contaminated soil, groundwater, and localized areas of hydrocarbon light non-aqueous phase liquid (LNAPL). Some of these potential AOCs represent areas that have resulted in localized groundwater plumes that have had their nature and extent characterized through investigative processes and continue to be monitored to evaluate stability and attenuation. A contaminant fate and transport modeling effort is ongoing, with the objective of further refining this Conceptual Site Model (CSM) through forecasts of plume stability attainment and assessment of potential receptors.

The outcomes from the investigative process have been the identification of constituents of interest that include Benzene, Tertiary butyl alcohol (TBA), Methyl tert-butyl ether (MTBE), Perchloroethylene (PCE), Trichloroethylene (TCE), Arsenic, and Lead. The extent of these constituents has been defined and potential pathways have been evaluated. A receptor evaluation (RE) was conducted at the Site in November 2016. Sensitive receptors are identified through assessing four (4) primary receptor evaluation categories: land use (on-Site and surrounding property use), groundwater use (wells), vapor intrusion (VI), and ecological receptors. No potential sensitive receptor exposure scenarios were identified through assessment of the first three receptor evaluation categories; while the assessment of the fourth category, the ecological receptor evaluation, is on-going.

This CSM has been developed to address two general questions:

- What are the potential risks to human health and the environment from previous Site operations?

And

- What are the nature, source, characterization, transport and degradation of chemicals of concern across the Site?

1.0 BACKGROUND INFORMATION

The Hess Corporation – Former Port Reading Complex (HC-PR, Site, or facility), located at 750 Cliff Road in Port Reading (Woodbridge Township), Middlesex County, New Jersey is an approximate 223-acre irregularly shaped parcel, situated in an industrially developed waterfront area. A Site Location Map is provided as **Figure 1**.

This CSM will assist in documenting the conditions and the physical, chemical, and biological processes that control the transport, migration, and potential impacts of contamination (in soil, air, groundwater, surface water, and/or sediments) to human and/or ecological receptors. The CSM presented herein, to be refined through future data collection efforts, has been developed to include descriptions of the environmental setting; potential sources; media and constituents of concern (COCs); migration pathways/contaminant fate and transport; and potential receptors. This report also discusses potential remedial action options based on current available data and Site information. The remedial action strategy for Site AOCs will continue to be evaluated and revised, if necessary, as new analytical results and Site information become available. Another factor that could influence or require changes to the remedial action strategy is the Natural Resource Damages suit filed by the New Jersey Department of Environmental Protection (NJDEP) on August 1, 2018, particularly as to restoration. Therefore, the proposed remedial actions summarized in **Section 7.0** should be considered preliminary at this time.

1.1 Site Description

The HC-PR facility is identified as Block 756, Lot 3; Block 756.01, Lots 1.02, 2, and 3; Block 756.02, Lots 1 and 8; Block 757, Lot 1; Block 760, Lot 6; Block 760.01, Lots 2 and 3; Block 760.02, Lots 1, 2, and 3; Block 1096.01, Lot 6; and Block 664.01, Lots 1.01 and 1.02.

The HC-PR facility is located east of Cliff Road and abuts the southern property boundary of the Conrail Port Reading Rail Yard. Immediately east-southeast of the Site is the Arthur Kill shipping channel, and to the south is the PSE&G Sewaren Generating facility. The former Port Reading Coal Docks, currently owned by Prologis Corporation, are located to the northeast. Port Reading Avenue is located to the northwest. A mixture of industrial and commercial properties are located to the west. Residential properties are located up-gradient to the northwest, and an industrial property is located to the south. A Site map is provided as **Figure 2**.

1.2 Site History

The HC-PR facility formerly processed low sulfur gas oils and residuals as feed to a Fluidized Catalytic Cracking Unit (FCCU) that converted gas oil into gasoline, fuel oil, and other hydrocarbon products (e.g., methane, ethane, and liquid petroleum gas). The HC-PR Site operations were initiated in 1958 with a Crude Topping Unit and underwent various expansions between 1958 and 1970. In 1974, refining operations were suspended, and the facility operated only as a bulk storage and distribution terminal until 1985. In April 1985, following a retrofit, the HC-PR facility resumed refining operations until February 2013. The refinery portion of the facility was demolished in 2015, and currently the Site is operated as a bulk storage and distribution terminal by Buckeye Partners, L.P. (Buckeye).

A 2015 Preliminary Assessment (PA) report identified 117 potential AOCs at the Site. **Attachment A** provides a list of the AOCs that have been defined in the 2015 PA report and have been investigated at this Site as part of the ongoing environmental investigations. Site AOC Maps are provided as **Figures 3.0** through **3.5**. A summary table and figure depicting all historic spill locations has been included as **Attachment B**.

Detailed operational records for the refinery are not available, however according to *Oil & Gas Journal*, the Port Reading refinery was a "critical supplier to the rapidly changing New York gasoline market." The refinery operations were relatively simple, initially using physical separation of crude oil into various petroleum mixtures such as gasoline, diesel fuel, marine diesel and multiple fuel oil grades with the Crude Topping Unit. "Light crude oil" was initially transported and utilized at the refinery for this simple separation and blending process. During the initial operational period of 1958 to 1970, more complex desulfurization, cracking and detailed distillation processes were added to the refinery.

When restarted in 1985, the refinery returned to focusing on the production of gasoline, motor fuels and fuel oil. The preferred feed stock was changed from crude oil to a middle distillate product known as gas oil. Although gas oils were more expensive than crude oil, the pre-processing that creates gas oil also removes many of the large, heavy hydrocarbon molecules that generate coke, bitumen and asphalt residual. Utilizing gas oil feed stock allowed Hess to focus on their core fuel products.

A general understanding of the refinery processes supports an understanding of the chemicals of concern that may be encountered in the soil and groundwater beneath the Site. During the initial refinery operation, crude oil was brought onto the Site and refined into various petroleum products. Based on general refinery operations, the simple Topping Unit refining process created the following petroleum products from the crude oil feed stock:

- Approximately 40% to 50% of all crude oil was separated into a gasoline product;
- 20% to 30% of all crude oil was separated into a diesel fuel or #2 fuel oil;
- 10% to 15% of all crude oil was separated into heavier fuel oils or paraffins;
- 5% to 15% created petroleum gases;
- and the remaining material was a residual petroleum product[1].

As described above, the Fluidized Catalytic Cracking Unit created both intermediate and final refined products. It is more difficult to generalize the mass fraction of the various products that were created. However, the principal product for the refinery remained gasoline and fuel oils for retail sale.

The generalized facility operations and the throughput of petroleum fluids provides a technique to evaluate the most appropriate chemical analytes to target historic fluid releases that may have occurred at the Site.

Table 1a – Targeted Chemical Analytes in Soil and Groundwater

Chemical Analyte	Potential Source Materials	Relative Degradation Potential
Extractable Petroleum Hydrocarbons – Category 2	Crude Oil Diesel Fuel Fuel Oils Bunker Oils Asphalts	Varying degradation potential based on the targeted chemical of concern

[1] US Energy Information Administration, an office of the US Department of Energy, Oil Petroleum Products Explained, September 23, 2020. https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil-the-refining-process.php,

Chemical Analyte	Potential Source Materials	Relative Degradation Potential
BTEX (Benzene, Toluene, Ethyl Benzene, Xylenes) and petroleum VOCs (Volatile Organic Compounds)	Crude Oil Gasoline Diesel Fuel Volatile Gas Oil Feed Stock	Moderate to high rate of degradation / bioattenuation
Naphthalene, 2-Methylnaphthalene 1-Methylnaphthalene Phenanthrene	Crude Oil Diesel Fuel Fuel Oils (#2, #4, #5, #6) Bunker Oils Volatile Gas Oil Feed Stock	Moderate rate of degradation / bioattenuation
Petrogenic Poly-Aromatic Hydrocarbons (PAHs)	Crude Oil Fuel Oils (#2, #4, #5, #6) Bunker Oils Asphalts	Moderate to low rate of degradation / bioattenuation
VOCs SVOCs TAL Metals PCBs	Other chemicals and fluids utilized at the facility	Varying degradation potential based on the targeted chemical of concern

As an example, approximately 50% of the fluid that was initially handled at the refinery was crude oil, approximately 25% of the fluid mass was manufactured gasoline, and approximately 7.5% of the fluid mass was manufactured diesel fuel or #2 fuel oil. An Extractable Petroleum Hydrocarbon (EPH) category 2 and a BTEX analysis in either soil or groundwater provides analytical data to evaluate a potential release from approximately 83% of all fluids handled at the Site. The advantage of this observation is the ability to compare Site conditions across the entire Site area. The investigation of a possible release in one AOC will generate data that can be compared to neighboring AOCs. This conclusion is reasonable based on-Site operations and the analytical guidance provided in the Technical Requirements for Site Remediation (TRSR).

The facility throughput provides an independent technique to characterize Site conditions and historic operations. When the refinery was refabricated and restarted in 1985, the facility was permitted for a throughput of 70,000 barrels (bbls) of feed stock per day. As described above, the preferred feedstock for the "restarted" refinery was a gas-oil material, which is manufactured from crude oil. The gas-oil feed stock generated very little waste, so it is a conservative assumption to estimate all gas-oil feed stock was refined into retail product; in other words, 1 bbl of gas-oil created approximately ½ bbl of gasoline and 1/4 bbl of diesel / #2 fuel oil, etc.

When fully operational, the refinery could process 2.9 million gallons of gas-oil into almost 2.9 million gallons of refined petroleum products. Most refineries operate 24-hours per day for months at a time with only limited periods of extended maintenance. It is reasonable to assume hundreds of millions of gallons of petroleum fluids were handled at the refinery in any calendar year. This equates to a virtually continuous transfer of fluids being delivered to the refiner, or staged prior to refining, or transferred to storage tanks, or transferred between storage tanks or transferred to the retail market.

Following a weight-of-evidence evaluation of the soil and groundwater analytes, EPH and BTEX analytes should be weighted higher than other chemicals of concern when evaluating the Site wide conditions and investigating the potential for releases of petroleum fluids. When the large volume of petroleum fluids that were transferred at the facility is considered, the evaluation of

EPH category 2 and BTEX chemical concentrations in soil or groundwater provides a very high confidence in the characterization of Site operations. The limited detections of elevated EPH or BTEX concentrations in soil and groundwater demonstrates the facility managed the large transfer of petroleum fluids very effectively and with very few releases to the environment.

As described in the various Remedial Investigation reports and this document, select areas of petroleum discharges have been identified on the Site; however, these areas are relatively small and horizontally isolated. The conceptual operational history for the facility indicates an investigator should focus on petroleum chemicals within the individual AOCs but continue to use the entire EPH / BTEX dataset to characterize the overall Site.

The EPH /BTEX rule of thumb for the Site is only a generalization of one potential source material, refined or unrefined petroleum fluids. Historic fill often includes EPH compounds from coal, ash, slag, wood, detritus, or other pyrogenic sources. All laboratory data should be evaluated in detail and scrutinized using the data quality management plans for the Site,

The remedial investigations follow all the analytical requirements defined in the TRSR (NJAC 7:26E, Table 2-1) and not just EPH and BTEX. Additional chemical analytes are consistently included in the laboratory analytes and all laboratory results are reported in the EDD submittals.

Sections 3.0 and **4.0** summarize all analytical data which has been collected from the Site. **Section 6.1** discusses the isolated wells where LNAPL has been detected.

1.3 Geologic and Hydrogeologic Conditions

1.3.1 Site Topography

Topography of the Site and surrounding area is generally flat with a very gradual slope towards the Arthur Kill. The total difference in topographic relief on the developed portions of the Site is approximately 17 feet. Surveyed ground surface elevations indicated that the developed portion of the Site, which has an approximate total area of 223 acres, ranges in elevation from 5 to 22 feet above MSL referenced to North American Vertical Datum on 1988 (NAVD88).

In addition, high resolution digital elevation data obtained collected using Light Detection and Ranging (LiDAR) methodologies were also evaluated as part of this CSM. A March / April 2014 LiDAR data set obtained from the US Geological Survey's National Map website (nationalmap.gov) that had a horizontal data spacing of approximately 1.3 ft (0.4 meters) is available for review. Surface features such as trees and structures were digitally removed from the LiDAR data set to create a digital elevation model (DEM). The resulting DEM was then compared to the existing topographic survey data and used for the construction of the conceptual geological cross-sections for the Site.

1.3.2 Surface Water Bodies

There are four surface water bodies relevant to the Site: the Arthur Kill, the north drainage ditch, Smith Creek, and the detention basin.

Arthur Kill: The Site is located adjacent to the Arthur Kill shipping channel located along the southeastern property boundary. The Arthur Kill is a salt water tidal estuary that has a peak water flux in excess of 14,126 cubic feet per second (400 cubic meters per second) observed in the vicinity of Raritan Bay.[2] Surface water gradients develop as a result of the tidal phase lag between the entrance to the Kill van Kull and Perth Amboy with localized contributions from persistent winds that drive the flow northwards as well as southwards through the Arthur Kill.[3]

The Arthur Kill is classified FW2-NT/SE-3. According to N.J.A.C. 7:9B Surface Water Quality Standards, FW2-NT/SE-3 indicates a saline estuarine waterway where a salt water/freshwater interface may exist. According to NJAC 7:9B, FW2-NT (non-trout) waters may be used for maintenance, migration, and propagation of natural biota; recreation; industrial and agricultural supply; public water supply (after filtration) and disinfection; and other reasonable uses. Waters classified as SE3 may be used for secondary contact recreation, maintenance and migration of fish populations, migration of diadromous fish, maintenance of wildlife, and other reasonable uses.

North Drainage Ditch: A man-made drainage ditch (North Drainage Ditch) and a Detention Basin are located onSite to control surface water prior to its flow to the Arthur Kill. The only water that enters the North Drainage Ditch is storm water that sheet flows outside of the containment areas on the north side of the property, as well as treated effluent water from the NJDEP permitted No. 1 Landfarm leachate treatment system. The ditch is open and directly connected to the Arthur Kill. The water level in the ditch varies from a depth up to 4 feet deep to dry over most tidal cycles. Two monitoring wells near the ditch, L1-3 and LN-6, were each influenced by tidal actions (**Appendix D**). However, the maximum tide cycle in the monitoring wells was less than 0.2 feet at a distance less than 75-feet from the ditch indicating a highly dampened tidal influence.

Smith Creek: Smith Creek is a former feature that cut across the central area of the Site from east to west. The center line of a portion of the former feature intersects with the current northern and western extent of the detention basin. The results from historical gauging events indicate that the former Smith Creek feature does not significantly influence groundwater flow directions in the shallow water bearing zone. The remaining portion of Smith Creek is located to the south of the subject property and still connects to the Arthur Kill.

Detention Basin: A Detention Basin (AOC 12) is located in the southwest portion of the Site and is approximately 800 feet by 600 feet in area with a depth of approximately 5 to 6 feet. This feature was created between 1966 and 1969. Storm water enters the Detention Basin through overland flow.

The detention basin is an unlined basin that is interpreted to be hydraulically connected to the shallow groundwater regime. The historical groundwater potentiometric and surface water elevation data indicates that the detention basin is hydraulically connected to the Site-wide shallow groundwater bearing zone. Data from a staff gauge DB-SW installed within the northern basin area indicates that this surface water feature acts as both a groundwater recharge and discharge zone. The results from the November 2019 gauging event (**Figure 3**) indicate that at that time the detention basin was functioning as an area of groundwater recharge with stage elevations of 7.58 ft-msl versus adjacent groundwater elevations of less than 7.0 ft-msl. As part of the facility's stormwater management plan, the water from the detention basin is periodically pumped out prior to storm events to increase capacity. This results in lower surface water

[2] Kaluarachchi, I.D., et al, June 2003 Estimating the volume and salt fluxes through the Arthur Kill and the Kill Van Kull, World Water and Environmental Resource Congress, Philadelphia, Pennsylvania.

[3] Pence, A.M., et al, April 2006, They hydrodynamics of the Newark Bay – Kills System, Prepared as a Component of the New Jersey Toxics Reduction Work Plan for NY-NJ Harbor Study I-E (SIT Component), Stevens Institute of Technology, Davidson Laboratory Technical Report SIT-DL-05-9-2840, Hoboken, New Jersey.

elevations that could temporarily make the detention basin groundwater recharge/discharge neutral.

Flooding Potential

A review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps, dated January 31, 2014 (preliminary), indicate that approximately ¾ of the Site is located within the 100-year flood zone. The 100-year flood zone extends from the eastern Site boundary extending west into the Site. The 500-year flood zone extends over portions of the northwest corner of the Site and the area east and southeast of the Administration Building. Non-flood zone areas extend over the western portions of the Site adjacent to Cliff Road and includes portions of the former refining operations area.

Wetlands:

According to the NJDEP GeoWeb Database, wetlands have been mapped on the Site along the north and east banks of the Detention Basin (classified as phragmites-dominant interior wetlands) and in the northeast portion of the Site along the western bank of the Arthur Kill (classified as saline marsh wetlands). Additionally, phragmites-dominant interior wetlands are identified on the adjacent properties north and south of the Site.

A partial wetland study was conducted at the Site as part of the No. 1 Landfarm and North Landfarm engineering cap permit applications. The partial study identified additional wetlands including two (2) intermediate resource value freshwater wetlands adjacent to the No. 1 Landfarm as well as the North Landfarm. The No. 1 Landfarm identified a freshwater wetland immediately southeast of the No. 1 Landfarm. Also a continuous freshwater wetland was identified north of the No. 1 Landfarm and the North Landfarm.

A report summarizing the Site's various wetlands is included as **Attachment G**. Overall, there are three distinct wetland communities located at the Site; 1) phragmites-dominated wetlands; 2) a much smaller area of freshwater wetlands with native vegetation and 3) an area of saline marsh wetlands. Site investigations will continue to avoid disturbance or damage to the existing wetland areas.

1.3.3 Underground Site Utilities

Due to the heavy industrial nature of the Site, many underground utilities are present or were historically present at the Site. The Site consists of several major underground oil and natural gas pipelines, as well as multiple smaller underground utilities including water, sewer, stormwater, and wastewater.

The underground oil and natural gas pipelines generally run laterally west and east across the Site along the northern boundary of the Site and in the center of the Site. Two (2) additional oil and natural gas pipelines run east and west in the southwestern portion of the Site and are diverted to run north and south in the south-central portion of the Site.

Of the smaller underground utilities, the stormwater network is of particular interest as there are at least two storm sewer systems. The original storm sewer system was sloped to the center of the Site to the former storm water treatment plant. More recently, Buckeye modified the storm sewer network which now discharges directly into the Arthur Kill.

Locations of major underground pipelines and other underground utilities at the Site are included in **Figure 2**. Additional subsurface structures include a network of monitoring wells as well as structural piles associated with Site buildings and infrastructure exist on-Site. The potential impact to shallow groundwater flow patterns posed by the presence of all these underground structures will be taken into consideration when evaluating groundwater conditions.

1.3.4 Regional Geology and Hydrogeology

According to the New Jersey Geological Survey (NJGS)[4] and NJDEP GeoWeb Database, the regional surficial geology consists of soils that were deposited during three main depositional periods:

- post-glacial
- glacial, and
- pre-glacial.

Post-glacial soils include historic fill overlying a discontinuous Quaternary (Holocene) estuarine and salt marsh (Meadow Mat) deposits that in turn overlies the glacial Pleistocene Rahway Till. Topographic high areas of the surrounding region often consist of localized glacial ice contact deposits and terminal moraines whereas topographic low areas away from the shoreline consist of localized glacio-lacustrine deposits attributed to glacial lakes including Lake Bayonne or Lake Ashbrook. Collectively, these Holocene post-glacial and Pleistocene glacial deposits overlie unconsolidated pre-glacial Cretaceous deposits that include the Raritan Formation. The primary post-glacial Holocene and glacial Pleistocene layers of interest for this CSM are the historic fill, the Meadow Mat, and the Rahway Till.

Post-Glacial

Historic fill was placed with the former salt marsh during several major importation events starting in the late 1800's and continuing through the 1970's. The historic fill layer generally consists of red to gray to black sand, silt, clay, gravel, and rock along with some man-made materials, such as bricks, glass, etc. Hydraulic properties of a historic fill layer are highly variable from a regional perspective and therefore not detailed herein.

The Holocene *Meadow Mat* interval generally consists of brown to dark gray peat and organic clay deposits with minor intervals of sand and shells. The base of the Meadow Mat interval may include alluvial sand and gravel deposits. The Meadow Mat interval is reported by Stanford (1999) to be up to 100 feet thick in this region. Published hydraulic properties for generic peat layers indicate a hydraulic conductivity of 18.7 feet per day (ft/day) which is equivalent to 6.6×10^{-3} centimeters per second (cm/sec).[5] Porosity values based on void ratio measurements from four samples of the Meadow Mat averaged approximately ±66% (percent).

Glacial

The *Rahway Till* interval consists of a reddish brown compact, firm to hard clayey sand to sandy silt with subrounded and subangular gravels and cobbles that is generally 10 to 30 feet thick across the region. Similar sandy glacial tills from southern New England reportedly exhibit hydraulic conductivities of 4.0×10^{-2} to 65.2 ft/day (1.4×10^{-6} to 2.3×10^{-2} cm/sec), porosities of 22.1 to 40.6% and specific yields of 3.9 to 31.2.[6]

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[4] Stanford, S.D., 1999, Surficial Geology of the Perth Amboy and Arthur Kill Quadrangles, Middlesex and Union Counties, New Jersey, Open File Map OFM 28, New Jersey Department of Environmental Protection Division of Science Research and Technology, and the New Jersey Geological Survey.

[5] Spitz, K. and J. Moreno, 1996, A Practical Guide to Groundwater and Solute Transport Modeling, John Wiley & Sons, Inc., New York.

[6] Melvin, R.L., et al., 1992, The stratigraphy and hydraulic properties of tills in southern New England, US Geological Survey Open-File Report 91-481, Hartford, Connecticut.

Pre-Glacial

The Cretaceous *Raritan Formation* outcrops along the fall line that runs from Middlesex County to New Castle, Delaware and extends eastwards towards the coastal areas. The Raritan Formation consists of the upper Woodbridge Clay Member and the lower Farrington Sand Member.[7] Localized areas of these Cretaceous sediments that were overlain by till deposits exhibit structural deformation as a result of being overridden by glaciers.[8] These areas reportedly exhibit overturned and recumbent folds and occasionally thrust faults. Localized beds of glacial till are reportedly folded or faulted into the Cretaceous sediments and in some areas these Cretaceous sediments are folded and faulted into the till. Clayey Cretaceous sediments also exhibit localized fracturing and are brecciated.

The *Woodbridge Clay* consists of a dark gray to black clay and micaceous silt with wood fragments, pyrite, and siderite that was deposited in a tropical mangrove swamp environment. Where present, the Woodbridge Clay functions as a confining layer. Published horizontal hydraulic conductivity values from Spitz and Moreno (1996) for similar silty clay layers range from 1.4×10^{-4} to 2.7×10^{-1} ft/day (4.8×10^{-8} to 9.4×10^{-5} cm/sec). Leakage rates for this confining layer derived from pumping test data vary from 7.0×10^{-4} to 2.3×10^{-3} feet per day per foot. The vertical coefficient of permeability or hydraulic conductivitiy of the Raritan Clay that includes the Woodbridge Clay is reportedly 1×10^{-3} ft/day (3.5×10^{-7} cm/sec).[9]

The *Farrington Sand* is a light gray to white quartz sand with thin gravel and thin red, white, and variegated silt and clay beds present that was deposited in a meandering stream environment. The Farrington Sand is considered a component of the middle aquifer of the Potomac-Raritan-Magothy (PRM) Aquifer. Water within the PRM Aquifer is fresh, moderately hard, and near neutral pH with elevated iron and manganese, and increased salinity near the coastline and Raritan Bay. Calcium-bicarbonate type waters dominate, and the aquifer has a medium yield of greater than 500 gallons per minute (gpm).

Transmissivity values of the middle PRM aquifer, which includes the Farrington Sand, varied from 2,140 ft^2/day in the northern areas of the aquifer (near the Site) to 13,800 ft^2/day.[10] Horizontal hydraulic conductivity values ranged from 36 to 200 ft/day (1.3×10^{-2} to 7.1×10^{-2} cm/sec) and vertical hydraulic conductivity values varied from 28 to 468 feet per day (ft/d) or 2.2×10^{-3} to 1.7×10^{-1} cm/sec. Storage coefficients for the middle PRM aquifer ranged from 2.6×10^{-5} to 3.4×10^{-3}.

Bedrock

The regional Bedrock Geology consists of the Passaic and Lockatong Formations and the Palisades diabase, as identified by the NJDEP GeoWeb Database in the vicinity of the Site. The

[7] Sugarman, P.J., 1996, Stratigraphy and hydrogeology of the Upper Cretaceous Raritan, Magothy, and Cheesequake Formations, New Jersey coastal plain, in Field Trip Guide for the 68th Annual Meeting of the NYSGA, edited by Alan Benimoff and Anderson Ohan.

[8] Volkert, R.A., et al., 2017, Bedrock Geologic Map of the Perth Amboy and Arthur Kill Quadrangles, Middlesex and Union Counties, New Jersey, New Jersey Department of Environmental Protection, Water Resources Management, Open File Map OFM-117.

[9] Rosenberg, S., 2013, Hydrogeology of Staten Island, New York, Master of Science in Geosciences Thesis, Stony Brook University, New York.

[10] Pucci, A.A., et al., 1989, Hydraulic properties of the middle and upper aquifers of the Potomac-Raritan-Magothy Aquifer System in the Northern Coastal Plain of New Jersey, New Jersey Department of Environmental Protection, Division of Water Resources, Geological Survey Report CN-029, Trenton, New Jersey.

Passaic and Locatong Formations are of the Piedmont Physiographic Province of Triassic and Jurassic Age. The Passaic Formation is present generally to the northwest of the railroad tracks along the northwestern property line. Most onsite bedrock is likely of the Locatong Formation with the eastern quarter of the Site likely underlain by Palisades diabase.

The *Passaic Formation* is considered the basal unit of the Brunswick Group of sediments that comprise the Brunswick Aquifer. The Brunswick Aquifer consists of the Passaic, Towaco, Feltville, and Boonton formations which are mostly reddish-brown feldspathic mudstone and micaceous siltstone with some claystone and fine-grained sandstones.

The *Lockatong Formation* is located beneath the Passaic Formation and is not considered part of the Brunswick Aquifer. The Lockatong Formation consists predominantly of cyclically deposited black dolomitic mudstone and marlstone and carbonate rich argillite. Other sediments that reflect the expansion and contraction of this lacustrine depositional environment include layers of black pyritic shale with carbon concentrations approaching 5%. Localized areas of the Lockatong Formation that are adjacent to diabase intrusions have been thermally metamorphosed to hornfels along the contact.

The *Palisades diabase* in the Newark Basin are essentially impermeable units that exhibit a sparsity of fractures and low hydraulic conductivity. The presence of diabase is expected to alter groundwater flow patterns and significantly reduce lateral and vertical recharge.

Regional Groundwater

Regional groundwater recharge rates of the shallow water table aquifer vary from 0 inches per year to 18 inches per year in the vicinity of the Site. Land use and land cover impact the regional groundwater recharge rates by influencing surface runoff and evapotranspiration. Industrialized areas often contain a high percentage of impermeable surfaces, such as roadways, parking areas, and structures that result in high runoff coefficients (0.7 to 0.9) and minimal groundwater recharge rates.

Topographically flat green space areas often result in low runoff coefficients (0.1 to 0.3) and high groundwater recharge rates. The results from M.A. French (1996) indicate that groundwater recharge from the infiltration of precipitation does not occur in the area surrounding the Site. Therefore, lateral movement of groundwater from upgradient areas towards the Arthur Kill rather than infiltration of precipitation is the primary mechanism for groundwater recharge in the vicinity of the Site.

1.3.5 Site-Specific Geology

Soil and groundwater investigations have been conducted on the Site for several years including the installation of dozens of soil borings and groundwater monitoring wells. **Figure 4.1** through **4.5** identify the location of most of the monitoring wells and borings that have been logged and installed on the Site. Similar to the regional surficial geology, the Site-specific geology consists of soils that were deposited during three main depositional periods:

- post-glacial
- glacial, and
- pre-glacial.

Post-glacial soils include historic fill overlying a discontinuous Quaternary (Holocene) estuarine and salt marsh (Meadow Mat) deposits that in turn overlies the glacial Pleistocene Rahway Till and possible localized glacio-lacustrine deposits along the shoreline. Collectively, these

Holocene post-glacial deposits and Pleistocene glacial deposits overlie 10 to 15-ft thick unconsolidated pre-glacial Cretaceous deposits (Raritan Formation) that lie above weathered bedrock.

Several cross-sections depicting the inferred Site stratigraphy are presented in **Figures 4.1** through **4.5**. These figures include plan views of each cross-section's orientation across the Site as well as the location of the wells and borings used in its creation. Each cross-section is based on Site-specific monitoring well log data supplemented with logs from relatively deep borings completed at or adjacent to the Site by the (NJGS as presented in Stanford (1999).

Post-Glacial Layers

A review of historic aerial photographs and topographic maps confirmed that the Site historically was defined by an upland shoreline to the west and north running parallel to the Cliff Road; and coastal dunes along the Arthur Kill to the east. Cradled between these two features were coastal salt marshes and the meandering Smith Creek. The central and western areas of the Site consisted of marshlands that bordered the western shore of the Arthur Kill. These former marshland areas appear to be present beneath the central and southeastern areas of the Site and are not present beneath the northern Site areas.

The southeast property boundary is classified by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey as "Pssa" (Psamments, i.e. unconsolidated sand deposits found in shifting coastal sand dunes). This former coastal dune shoreline composes just 3% of the Site. This unit consists of well-drained sandy deposits with shallow 0 to 3 percent slopes that often do not have clear designations between other soil horizons. The cross-sections in **Figures 4.1, 4.2** and **4.5** show how these former coastal dunes and former shoreline relate to the layers of fill and the remainder of the meadow mat found at the Site.

According to the USDA NRCS Web Soil Survey, approximately 96% of the Site is classified as UR (Urban Land). UR soils consist of disturbed, natural soil, and fill material covered by pavement, concrete, buildings, and other structures. The southeast property boundary is defined by the shoreline along the Arthur Kill.

Fill Placement History

In the late 1890's, the northern portion of these salt marshes were filled and numerous railroad spurs were extended to the Arthur Kill shoreline. In the 1800's, the area was referred to as Salt Meadows Landing. In the years leading up to the 1950's, a small village consisting of several residential homes and related outbuildings were constructed in this area along the northwestern shoreline of Smith's Creek in the northwest corner of the property. This village was located between the area currently identified as AOC 60 (the Avenue B Tankfield) and AOC 37 (the No. 2 Oil Detergent Additive Truck Unloading Area). Conceptually, the presence of this former village is significant in that it indicates this area consisted of solid upland material and not low-lying marshland, as confirmed by the presence of surficial Rahway Till and the lack of meadow mat beneath the thin layer of historic fill in this area.

In the mid-1940's, historic fill was placed in the marshes on the adjacent property to the south of the Site for the construction of an oil-fueled power plant at the current location of the PSEG power facility. Throughout the 1950's, historic fill was placed in the onsite marshes to create property for industrial/commercial development. Smaller fill placement events occurred in the 1960's and 1970's to create the land underlying the former stormwater treatment plant area and backfill the former oily lagoons in the south-central portion of the property.

Historic Fill Layer
As shown in **Figures 4.1** to **4.5**, the historic fill layer is discontinuous and limited to thin layers present beneath impermeable surfaces or backfill for utilities on the western portion of the Site (i.e. the existing upland areas along Cliff Road and the western shoreline of Smith's Creek). Locally thicker amounts of historic fill were placed where berms or tank pads were constructed. The historic fill layer grows thicker and continuous across the remainder of the Site as it progresses to the east overlying the Meadow Mat in the central and southeastern areas of the Site to the bulkhead along the Arthur Kill.

The historic fill materials range in thickness from near zero feet in the northern areas of the Site near Cliff Road (as shown in boring PER-5) to greater than 15 feet in the southern Site areas near the detention basin (reference boring PER-9DD) and the bulkhead and dock structures as indicated in borings PER-7 and PER-8. These deposits have variable colors that range from red, to brown, to yellow, to gray, to black with reddish brown apparently being the most common color identified. Texture of the fill is also variable as expected with clay or sandy or gravelly clay seemingly being most prevalent. Wood debris is occasionally encountered within the historic fill materials layer. The base of the fill material is generally identified by the interface with an organic gray or brown clay layer that represents the top of the Meadow Mat layer. The geologic log for monitoring well location PER-9DD is a type-log for this contact which occurs at a depth of 15 feet bgs.

Meadow Mat Layer
As shown in **Figures 4.1** to **4.5**, the Meadow Mat layer underlies the fill materials in the central and southeastern areas of the Site. The Meadow Mat is absent in the upland areas from the former western shoreline of Smith's Creek toward Cliff Road and the railroad line along the western property line. The Meadow Mat layer is composed of brown to gray organic clay, sandy clay, and silt deposits with organic and peat intervals present. A discontinuous layer of gray alluvial sand is present at the base of the Meadow Mat layer near the southern extent of the Site as observed in the boring log for PER-10D. The Meadow Mat layer, where present, has been observed to be up to approximately 50 feet thick, as logged during the drilling and completion of monitoring well SC-2DDD.

<u>Glacial Layers</u>
As shown in **Figures 4.1** to **4.5**, a red to reddish brown clayey sand to sandy silt layer with some gravel, cobbles, and boulders is discontinuous beneath the Site and is believed to represent the Pleistocene *Rahway Till*. The Rahway Till is at or near the surface in the northern areas of the Site where it may locally rest on bedrock. The Rahway Till rests on the Cretaceous Woodbridge Clay or Farrington Sand in other areas of the Site. The Rahway Till was reported by Stanford (1999) to be 40 feet thick near Cliff Road at the northern extent of the Site based on observations from boring 26-26232 (Boring #310) that was completed by the NJGS. The Rahway Till was observed to be 23 feet thick at monitoring well SC-3DDD (southwest of the Detention Basin) where it appears to overlie weathered diabase bedrock.

The Rahway Till may be discontinuous in the central areas of the Site. There is some evidence in the boring log record to suggest that the Rahway Till may have been eroded by the ancestral Hudson River resulting in a disconformity or perhaps never deposited resulting in a nonconformity. The Rahway Till may be absent at NJGS Boring 26-9305 (Boring #312) as shown on **Figure 4.1** and also absent at monitoring well PER-9DD, which is located west of the Detention Basin. In addition, the Meadow Mat layer is underlain occasional by a discontinuous light gray silty to clayey fine to medium sand layer which is inconsistent with the red-brown color of the Rahway Till. This light gray layer may represent glacio-lacustrine deposits from Glacial Lake Ashbrook or Glacial

Lake Bayonne. The geologic log for monitoring well PER-9DD could indicate that a glacio-lacustrine deposit rests directly on top of a very dense gray clay thought to represent the pre-glacial Cretaceous Woodbridge Clay. This data suggests that the Rahway Till may be discontinuous beneath the Site, however the NJGS logs for the Site are inconclusive with regards to this theory.

Pre-Glacial Layers

Raritan Formation

As shown in **Figures 4.1** to **4.4**, a discontinuous dark gray clay layer that grades into a light gray sand layer is occasionally observed beneath the Rahway Till, as evidenced at monitoring well location AD-2DD, or beneath the suspected glacio-lacustrine deposits where the till may be absent. The dark gray clay layer is believed to represent the pre-glacial Cretaceous *Woodbridge Clay* and the white to light gray to greenish gray sand or clayey sand layers are believed to represent the *Farrington Sand*. Test Boring 26-1829 (Boring #313) from the NJGS's database is located in the eastern wetlands and green space area of the Site. Boring #313 indicates that the Woodbridge Clay and Farrington Sand units are approximately 50 feet thick and overlying diabase bedrock beneath this area of the Site.

Weathered Bedrock

As shown in **Figures 4.1** to **4.3**, weathered bedrock was encountered at various locations beneath the Site. Boring log AD-2DD indicates that gray weathered mudstone bedrock was encountered 55 feet bgs in the north-central areas of the Site. This weathered bedrock zone is likely associated with the Lockatong Formation. Greenish gray silty clay and gravels were observed at depths of 55 to 60 feet bgs at SC-4DD in the southwestern areas of the Site. These observations suggest that the bedrock in these areas is either weathered hornfels associated with contact metamorphism of the Lockatong Formation or weathered diabase. These observations are consistent with the delineation of bedrock lithology presented in the geologic map of the Perth Amboy and Arthur Kill Quadrangles present in Volkert, et al. (2017).

1.3.6 Site Hydrogeology

Land use and land cover influence groundwater recharge through the infiltration of precipitation and surface water. The 223-acre industrial Site consists of a variety of surfaces that include 103 acres of developed land that includes impervious surfaces such as asphalt, concrete, low permeability soils or structures and approximately 33-acres of wetlands or the detention basin surface water feature. These wetland and detention basin features appear to alternate between areas of groundwater recharge and groundwater discharge in response to the elevation of the water table and tidal fluctuations in areas immediately adjacent to the Arthur Kill.

The remaining 87-acres are surfaces that exhibit variable permeability due to the presence of near surface Rahway Till or historic fill materials. Within these undeveloped/unpaved areas, infiltration of precipitation likely occurs at rates up to 40% of the annual regional precipitation or up to approximately 18-inches per year as supported by aquifer recharge potential data from French (1996). However, the limited lateral extent of these precipitation infiltration areas suggests that the primary source of groundwater recharge beneath the Site is from lateral groundwater flow from upgradient source areas rather than from infiltration of precipitation.

Site monitoring wells have been installed in three (3) hydrostratigraphic units that are referred to as water-bearing zones. These three water-bearing zones generally correspond with three monitoring well completion intervals.

- Shallow water-bearing zone (unconfined): 0 to 15 feet bgs

- Intermediate water-bearing zone (semi-confined): 15 to 35 feet bgs
- Deep water-bearing zone (confined): 35 to 65 feet bgs

All three of the water-bearing zones should be classified as non-potable Class IIB groundwater quality aquifers primarily due to the high groundwater saline content given the Site's proximity to the tidally influenced sea water of the Arthur Kill. **Figures 5.1** through **5.3** show groundwater contours drawn for these three water-bearing zones based on well gauging data collected on November 2019. This data set is representative of typical onsite hydrogeological conditions that will be used as reference in the following sections describing the inferred behavior of these water-bearing zones. **Figures 5.4** and **5.5** show the distribution of the monitoring wells used to collect Site-specific data via in-situ hydraulic conductivity (slug) testing. **Figure 5.4** identifies the distribution of the monitoring wells tested in terms of the water-bearing zone each well is screened across. **Figure 5.5** shows the distribution of the monitoring wells tested in terms of the geologic layer each well is screened across.

Shallow Water-Bearing Zone

The shallow water-bearing zone corresponds to groundwater monitoring wells installed to depths of approximately 10 to 15 feet bgs. These shallow monitoring wells are generally completed within the one of three lithologic zones; the historic fill material which is most frequently encountered across the central portion of the Site; the upper section of the Meadow Mat in the central and southern areas of the Site or within the sandy Rahway Till that is present near the surface in the northwestern portion of the Site. Hydraulic investigations have been completed within multiple shallow monitoring wells as described below.

As shown in **Figure 5.1**, the unconfined shallow water-bearing zone's horizontal hydraulic gradients are generally small with localized differences noted as a result of lateral changes in hydrostratigraphy (specifically the Rahway Till diving from northwest to southeast) and the presence of engineered features such as the detention basin and a steel sheet pile bulkhead along the Arthur Kill shoreline. The outcome from an analysis of the horizontal hydraulic gradient is that the shallow groundwater across the Site has an overall southeasterly flow direction towards the Arthur Kill at a gradient of approximately 1.9×10^{-3} ft/ft with localized westward flow noted in the vicinity of the detention basin and other areas (**Figure 3**). The relatively similar groundwater gradient supports the slug testing observation that the shallow soils exhibit similar hydraulic conductivities as detailed below.

An exception to this observation is noted in the vicinity of the AD cluster of monitoring wells (northern Site area) where a relatively steep horizontal hydraulic gradient persists. A review of the geologic logs from this area appear to indicate the presence of the Rahway Till. This heterogenous till transitions from a permeable sandy glacial till upgradient from this feature to a slightly lower permeability clayey glacial till downgradient from the feature. Limited slug test results (as detailed below) indicate that the sandy and clayey glacial tills have average hydraulic conductivity values of 7.1 ft/day and 9.8×10^{-1} ft/day, respectively. This observation suggests that this steep hydraulic gradient is due to a localized lateral change in the texture and permeability of the glacial till resulting in the creation of a natural feature that acts like a leaky groundwater flow barrier.

Former Smith Creek Channels and AOC 12 (Detention Basin)

Smith Creek is a former feature that cut across the central area of the Site from east to west. The former extents of Smith Creek are shown on most of the Site figures provided in this CSM. In the late 1950's, historic fill placement activities fill most of the former Smith Creek channel. Based on a review of boring logs located in and around the former Smith Creek, it can be inferred that at the time of backfilling the beds of the two main channels were likely at average elevations between 5 and 10-ft below msl. This inference is made by the presence of gravelly layers of organic sediment, deeper layers of historic fill, as well as taking into account the compression of the meadow mat by the weight of the historic fill.

The results from historical gauging events indicate that the former Smith Creek channels do not significantly influence groundwater flow directions in the shallow water bearing zone. However, the rising slope of the Rahway Till that defined the western shoreline of Smith Creek (and by extension the western shoreline of the detention basin) does affect localized groundwater flow direction to the south towards the detention basin as shown in **Figure 5.1**. This localized southernly groundwater flow direction may also be influenced by the Site's stormwater network. The Site's original storm sewer system was sloped to the center of the Site to the former storm water treatment plant. The utility trenches for these storm sewer lines may act as a preferential pathway for shallow groundwater and may be in part be responsible for a localized groundwater mounding effect observed in the center of the Site.

The detention basin (AOC 12) is an unlined basin that is interpreted to be hydraulically connected to the shallow groundwater regime. This feature is believed to represent both a source of groundwater recharge and an area where groundwater discharges. The results from the November 2019 gauging event (**Figure 3**) indicate that at that time the detention basin was functioning as an area of groundwater recharge with surface water elevations of 7.58 ft-msl versus adjacent groundwater elevations of less than 7.0 ft-msl. As part of the facility's stormwater management plan, the water from the detention basin is periodically pumped out prior to storm events to increase capacity. This results in lower surface water elevations that could temporarily make the detention basin groundwater recharge/discharge neutral.

Bulkhead
As shown in **Figure 5.1**, the hydraulic gradients across the remainder of the Site are relatively low (flat) and decrease southwards towards the Arthur Kill. These low hydraulic gradient areas may be due in part to a steel sheet pile bulkhead along the Arthur Kill. The bulkhead is composed of interlocking steel sheet piles driven to an elevation of -42 ft-msl. Data from a peer reviewed publication and the results from calibrated groundwater models prepared for similar sites indicates that these types of walls have hydraulic conductivity values of approximately $3x10^{-2}$ ft per day.[11] This low hydraulic conductivity feature appears to contribute to the creation of a groundwater stagnation zone across the central and southern areas of the Site.

Slug Testing Results: Shallow Water-Bearing Zone
Historic Fill Layer: In-situ hydraulic conductivity (slug) testing results from the fill layer completed in 2014 and 2020 indicated a range of values of 0.9 ft/day to 35.7 ft/day ($3.2x10^{-4}$ to $1.3x10^{-2}$ cm/sec) with a median value of 3.0 ft/day ($1.1x10^{-3}$ cm/sec). Average hydraulic conductivity values from this data set were determined to be 10.7 ft/day ($3.7x10^{-3}$ cm/sec), and standard deviation of 13.0 ft/day ($4.6x10^{-3}$ cm/sec) resulting in a high coefficient of variation of 1.2 which is indicative of a hydraulically heterogeneous fill deposit.

Meadow Mat Layer: Some of the shallow zone monitoring wells partially penetrate the top of the Meadow Mat layer. Slug tested monitoring wells PER-7, L1-2, and TR-4D were partially completed across the fill / Meadow Mat interval and location SC-2 was screened entirely within the Meadow Mat. A weighted average approach based on the percentage of the target formation

[11] Sellmeijer, J., J. Decker, and W. Post, 1995, Hydraulic resistance of steel sheet pile joints, Journal of Geotechnical Engineering, pp. 105-110.

screened was used to converge on a mean hydraulic conductivity value of 3.6 ft/day ($1.3x10^{-3}$ cm/sec) for the top of the Meadow Mat in these areas. This average hydraulic conductivity value is less than the published value of 18.7 feet per day for a generic peat deposit and the difference may be representative of the silt and clay intervals present in the Meadow Mat deposit.

Rahway Till Layer: Slug test results from the sandy glacial till layer were collected from one location (AD-3) where the results ranged from 4.6 to 6.8 ft/day ($1.7x10^{-3}$ to $2.4x10^{-3}$ cm/sec). These hydraulic conductivity values for the Rahway Till are consistent with published values of sandy glacial till from southern New England.

Conclusions: Slug testing indicates the shallow soils present similar hydraulic conductivities. Variations in individual well performance may be a factor of well construction, well installation or minor variability in grain size of the soil. Considering the size of the Site, the upper aquifer zone may be evaluated as one common unit for overall groundwater recharge and transport characteristics. Localized evaluations should be limited to individual chemical release areas.

Based on these slug test results, a summary of the groundwater flow (seepage) velocities for the shallow water-bearing zone for various areas and various subsurface materials are presented in **Table 1b**. As summarized below, the shallow water-bearing zone in the northern area of the Site consists of the sandy and clayey Rahway Till layers. The shallow water-bearing zone in the basin, central, and southern areas of the Site consist of the historic fill layer and Meadow Mat. Effective porosity values used for this exercise were based on published values as presented in Spitz and Moreno (1996). A value for fine sand alluvium of 43% was used for the artificial fill layers. Effective porosity values for silty clay of 31% was used for the Rahway Till.

Table 1b. Estimated Hydraulic Conductivities of the Shallow Water Bearing Zone

Well ID	Screened Geologic Interval	Porosity	$K_{falling}$ (ft/day)	K_{rising} (ft/day)	K_{avg} (ft/day)
AD-3	Glacial Till	0.31	4.59	6.80	5.69
BG-2	Fill	0.43	0.95	0.87	0.91
L1-2	Fill & MeadowMat	0.45	35.73	34.75	35.24
LN-5	Fill	0.43	0.88	0.35	0.61
LS-1R	MeadowMat & Glacial Till	0.43	0.17	0.22	0.20
PER-2	Fill & MeadowMat	0.66	0.48	-	0.48
PER-5	Fill & Glacial Till	0.41	0.44	-	0.44
PER-6R	MeadowMat & Glacial Till	0.31	2.22	2.07	2.14
PER-7	Fill & MeadowMat	0.51	2.40	3.68	3.04
PL-8R	Glacial Till	0.31	0.28	-	0.28
SC-2	Meadow Mat	0.66	0.60	-	0.60
TL-2	Fill	0.43	10.64	13.40	12.02
TR-4R	Fill & MeadowMat	0.55	2.01	1.53	1.77

Notes:

1. Effective Porosity Values for Fill Based on Published Values from Spitz and Moreno, 1996.
2. Effective Porosity Values for the Rahway Till Based on Published Values from Melvin, 1992.
3. A Weighted Average Effective Porosity Value was used for Wells Completed Across Multiple Formations.
4. Effective Porosity Values for Meadow Mat Based on Average Laboratory Results of Four Samples Tested for Void Ratio.

Intermediate Water-Bearing Zone

The semi-confined intermediate water-bearing zone corresponds to groundwater monitoring wells installed to depths of approximately 25 to 35 feet bgs. Intermediate zone monitoring wells located in the *northern portion* of the Site are generally completed in the glacial Rahway Till layer. The monitoring wells in the *basin area* of the Site are generally completed within the permeable Meadow Mat layer that is made up of organic sandy silt/silty sand substrate with some well screens installed within lenses of clay and sand. Some intermediate zone wells in the *basin, central, and southern areas* of the Site penetrate into the top of the underlying glacial Rahway Till layer (or the possible glacio-lacustrine deposit layer) that is composed of fine sand and silt.

Vertical Gradient Analysis: Intermediate Water-Bearing Zone

The presence or absence of a confining layer for the intermediate zone wells was determined based on a review of the historical vertical gradient data. Vertical hydraulic gradient data was evaluated for co-located wells completed in the shallow, intermediate, and deep groundwater-bearing zones for the purpose of determining the presence of confining layers and the potential for the vertical migration of groundwater and dissolved constituents of interest. The vertical gradient calculations associated with the May 2020 groundwater gauging data are presented in **Table E-1** of **Attachment E**.

The results from this evaluation indicated that vertical gradients are generally oriented downward from the shallow to the intermediate groundwater-bearing zones. The results from the vertical gradient data also indicates that the intermediate zone acts as both a locally confined and unconfined aquifer. Localized areas in the north exhibit the characteristics of an unconfined aquifer whereas several localized areas elsewhere onsite appear to exhibit marginal confined water bearing zone characteristics. These results infer that the detention basin may not be hydraulically connected to the intermediate groundwater bearing zone which is suggested by the potentiometric surface results presented as **Figure 5.1**. The presence of localized transitions from confined to unconfined conditions within the intermediate zone results in non-detectible or insignificant variability in lateral contaminant transport properties.

A summary of the groundwater flow (seepage) velocities for the intermediate water bearing zone for various areas and various subsurface materials are presented in **Table 1c**. The porosity of the organic layers of the Meadow Mat deposit were measured in four samples collected from borings KB18-8, KB18-9, KB19-1, and KB19-2 and were found to range from 57 to 76% with an average value of 66%. Effective porosity values of 31% were used as being representative of the Rahway Till. This effective porosity is based on published values from similar glacial till deposits in southern New England as presented in Melvin (1992). Groundwater flow directions in the intermediate groundwater bearing zone are southwestwards with variable groundwater flow velocities as shown in **Table 1c**.

Table 1c. Estimated Hydraulic Conductivities of the Intermediate Water Bearing Zone

Well ID	Screened Geologic Interval	Porosity	$K_{falling}$ (ft/day)	K_{rising} (ft/day)	K_{avg} (ft/day)
AB-4D	Meadow Mat	0.61	3.62	3.87	3.75
AD-3D	Rahway Till (Sandy)	0.31	9.02	7.25	8.13
AD-9D	Rahway Till (Sandy)	0.31	11.99	16.07	14.03
PER-9D	Meadow Mat	0.66	19.49	38.69	29.09
PER-10D	Meadow Mat	0.66	11.79	-	11.79
TR-4D	Farrington Sand/ Woodbridge Clay	0.45	1.38	1.56	1.47

Notes:

1. Effective Porosity Values for Rahway Till Based on Published Values from Melvin, 1992.
2. A Weighted Average Effective Porosity Value was used for Wells Completed Across Multiple Formations.
3. Effective Porosity Values for Meadow Mat Based on Average Laboratory Results of Four Samples Tested for Void Ratio.

Deep Water-Bearing Zone

The confined deep water-bearing zone monitoring wells are installed at depths of approximately 50 feet to greater than 65 feet bgs. These monitoring wells have screened intervals within permeable clay or silty clay substrate thought to be representative of the pre-glacial Cretaceous Woodbridge clay or Farrington sand deposits. Several wells are completed within lenses of silty sand and weathered shale, hornfel, or diabase bedrock. The vertical gradient data suggests that the deep water-bearing zone has the characteristics of a confined aquifer (**Attachment E**).

Slug Testing Results: Deep Water-Bearing Zone

Woodbridge Clay / Glacio-Lacustrine Deposit: Slug test results from wells thought to be completed across the interface of the overlying glacio-lacustrine deposit and the pre-glacial Cretaceous Woodbridge Clay deposit had an average value of 6.0 ft/day ($2.1x10^{-3}$ cm/sec). These hydraulic conductivity results were higher than anticipated due to the presence of the sandy layers of the glacio-lacustrine deposits.

Farrington Sand: Slug test results from wells thought to be completed across the interface of the pre-glacial Cretaceous Farrington Sand ranged from 5.9 ft/day ($2.1x10^{-3}$ cm/sec) to 11.9 ft/day ($4.2x10^{-3}$ cm/sec) with an average value of 8.9 ft/day ($3.1x10^{-3}$ cm/sec). These hydraulic conductivity values are less than the published values of 36 to 200 ft/day presented by Pucci (1989) possibly indicating the presence of a component of fine textured sediment within these deposits beneath the Site.

Conclusions: A summary of the groundwater flow (seepage) velocities for the deep water-bearing zone for various areas of the Site and various subsurface materials are presented in **Table 1d**. Groundwater flow directions in the deep groundwater bearing zone is southwards with variable groundwater flow velocities as shown on **Table 1d.** Effective porosity values used for this exercise were based on published values for similar glacial till deposits found in southern New England (31%) for the clayey Rahway Till as presented in Melvin (1992). Published values for silty clay (38%) were considered representative of the weathered bedrock as presented in Spitz and Moreno (1996).

Table 1d. Estimated Hydraulic Conductivities of the Deep Water-Bearing Zone

Well ID	Screened Geologic Interval	Porosity	$K_{falling}$ (ft/day)	K_{rising} (ft/day)	K_{avg} (ft/day)
AD-2DD	Farrington Sand	0.38	8.60	11.51	10.05
AD-9DD (2020)	Farrington Sand/ Woodbridge Clay	0.31	0.37	0.56	0.46
AD-9DD (2021)	Farrington Sand/ Woodbridge Clay	0.31	0.73	0.44	0.59
AD-10DD	Farrington Sand/ Woodbridge Clay	0.31	0.18	0.26	0.22
PER-9DD	Woodbridge Clay	0.38	8.34	10.02	9.18
SC-2DD	Woodbridge Clay / Weathered Bedrock	0.42	4.20	5.36	4.78
SC-2DDD	Weathered Bedrock	0.38	1.45	2.30	1.88
SC-3DDD	Woodbridge Clay / Weathered Bedrock	0.38	0.39	--	0.39
TR4-DD	Farrington Sand / Weathered Bedrock	0.38	--	12.06	12.06
TR5-DD	Farrington Sand	0.38	--	8.26	8.26

Notes:

1. Effective Porosity Values for Weathered Bedrock, Woodbridge Clay, or Farrington Sand Based on Published Values from Spitz and Moreno, 1996.
2. Effective Porosity Values for Clayey Rahway Till based on Published Values from Melvin, 1992.
3. A Weighted Average Effective Porosity Value was used for Wells Completed Across Multiple Formations.

Tidal Studies

Two tidal studies have been completed at the Site: one in 2002 and a second in 2020. Based on the 2002 tidal study, the HC-PR facility wells located adjacent to the Arthur Kill are affected by tidal influences. However, interior Site wells were generally unaffected by tides. An additional tidal study was conducted in August 2020 utilizing data collected from twenty (20) Site monitoring wells. The monitoring wells were selected based on spatial disbursement throughout the Site and to represent different depth intervals, as well as favoring wells that have significant VOC impacts.

Bulkhead: The results from the tidal studies indicate that the presence of the steel sheet pile bulkhead effectively dampens and minimizes the diurnal tidal influences on the groundwater regime beneath the Site. Construction information from the bulkhead restoration project demonstrates that the base of the sheet piles were driven to an elevation -42 ft-msl. This information demonstrates that the bulkhead wall extends across the shallow, intermediate, and much of the deep water-bearing zone. Information presented in **Section 1.3.3** of this CSM indicates that similar steel sheet pile walls with unsealed interlocking joints exhibit low hydraulic conductivity values of approximately $3x10^{-2}$ ft/day ($1.1x10^{-5}$ cm/sec). The presence of a bulkhead with a relatively low hydraulic conductivity is anticipated to result in the attenuation of groundwater flow and a minimization of the influences of tides on the upgradient groundwater regime.

No Tidal Influences: Locations where no diurnal tidal influences were observed in monitoring wells SC-4 (shallow zone well located within the footprint of ancestral Smith Creek), TF-3 (Central Area shallow zone well), TR-3D (Basin Area intermediate zone well), and TR-5 (Basin Area shallow zone well). These results provide further evidence that the bulkhead functions as a vertical barrier that minimizes tidal influences by attenuating groundwater flow in the shallow, intermediate, and deep groundwater bearing zones. In addition, the lack of tidal influence at these well locations may be further assisted by completion intervals that are hydro-stratigraphically discontinuous.

Minor Tidal Influences: Locations where minimal or minor diurnal tidal influences were observed (e.g. periodic changes on the order of a few hundredths of feet or less) include shallow zone well TL-2 that is located adjacent to the bulkhead, intermediate zone wells AD-9D and TR-5D and Basin Area deep zone wells such as PER-2DD and TR-3DD. These results provide further evidence that the bulkhead functions as a vertical barrier that minimizes tidal influences by attenuating groundwater flow in the shallow, intermediate, and deep groundwater bearing zones.

Significant Tidal Influences: Locations where significant tidal influences are observed (e.g. periodic changes on the order of tenths of feet) are limited to areas near inland surface water features that are hydraulically connected to the Arthur Kill. These monitoring wells that exhibited significant tidal influence are located near the Site boundaries. These monitoring well locations included shallow monitoring wells L1-3 and LN-6 (located adjacent to the north drainage ditch) and PER-3D (located adjacent to the Detention Basin).

2020 Tidal Study: The following table presents an overview of the August 2020 tidal study results:

Tidal Influence Status	Number of Monitoring Wells	Spatial Description of Corresponding Monitoring Wells
No Tidal Influence	4	Generally located throughout the site and within the shadow of the bulkhead and completed in units that may be hydro-stratigraphically discontinuous. These locations include wells completed within the shallow and intermediate water-bearing zones.
Minor Tidal Influence	13	Generally located throughout the Site and within the shadow of the bulkhead with completion intervals within the shallow, intermediate, and deep water-bearing zones.
Significant Tidal Influence	3	Generally located adjacent to surface waterbodies that are hydraulically connected to the Arthur Kill and function as localized areas of groundwater discharge and recharge.

A detailed summary of the August 2020 tidal study is included as **Attachment D**, which includes a tidal study summary table, a tidal study results map, and depth to water vs. tide graph for each monitoring well incorporated in the study (includes both evenly scaled x-axes and unequally scaled x-axes to show detail).

A series of rain and thunderstorm events occurred on August 7, 2020 during the data collection effort for this updated tidal study. This rain event produced approximately 0.7 inches of precipitation as recorded at the Newark Liberty International Airport Station. The short-term impact from this storm can be observed in the transducer data of some of the shallow Site monitoring wells with near surface completions such as PL-8R, SC-4, TF-3, TR-3D, and TR-5. However, the impact from this event did not eliminate or degrade the ability to assess tidal influences at these locations.

The installation of several additional monitoring wells is proposed during future investigation activities. A future study involving these new wells will assist in further defining the limits of tidal influence to onsite groundwater flow.

2.0 NATURE AND EXTENT OF SITE IMPACTS

Soil, groundwater, and sediment impacts have been investigated to the Site boundaries. Groundwater impacts have been investigated and delineated off-site to the southeast of the Site. Soil and groundwater impacts have been detected throughout the Site and are summarized in **Sections 3.0** and **4.0**. Sediment impacts have been identified in limited portions of the Site as summarized in **Section 5.4**.

This section provides a discussion of the soil and groundwater contaminant sources and the Site-specific mechanisms for contaminant migration.

2.1 Characterization of Soil Contaminant Sources

The sources of soil contamination at the Site are shown on **Figures 6.1** through **6.5** that present Site Wide Hot Spot Soil Exceedance Maps for EPH, VOCs, Semi-Volatile Organic Compounds (SVOCs), Metals, Polychlorinated Biphenyl and (PCBs). These areas of soil contamination may represent persistent sources of groundwater contamination depending upon the mass present, solubility, and mobility of the contaminant and the permeability of the host material.

The following table identifies the COCs that have been detected in Site soils during investigations conducted from 1993 through 2019 and in groundwater during the 2019 annual sampling event, the media(s) of concern, and the potential COC source.

COC Suite	Specific COC	Impacted Media	Potential COC Source
Extractable Petroleum Hydrocarbons (EPH)	Extractable Petroleum Hydrocarbons (EPH)	Soil and sediment	Site operations
Volatile Organic Compounds (VOCs)	1,1-dichloroethene	Groundwater	Site operations
	1,1,1-trichloroethane	Groundwater	Site operations
	1,1,2-trichloroethane	Groundwater	Site operations
	1,1,2-trichloroethene	Soil	Site operations
	1,1,2,2-tetrachloroethane	Soil	Site operations
	1,2-dichlorobenzene	Soil (above DIGWSSL only) and groundwater	Site operations
	1,2-dichloroethane	Soil and groundwater	Site operations
	1,2-dichloropropane	Soil and groundwater	Site operations
	1,2,4-trichlorobenzene	Soil and groundwater	Site operations
	1,3-dichlorobenzene	Soil (above DIGWSSL only) and groundwater	Site operations
	1,4-dichlorobenzene	Soil and groundwater	Site operations
	3,3-dichlorobenzidine	Soil	Site operations
	Acrolein	Soil	Site operations
	Acrylonitrile	Soil	Site operations
	Benzene	Soil, sediment, and groundwater	Site operations
	Bis(2-chloroethyl)ether	Soil	Site operations
	Bromochloromethane	Soil (above DIGWSSL only)	Site operations
	Carbon disulfide	Sediment	Site operations
	Carbon Tetrachloride	Soil	Site operations
	Chlorobenzene	Soil (above DIGWSSL only) and groundwater	Site operations
	Chloroform	Soil	Site operations
	Cis-1,2-dichloroethene	Soil (above DIGWSSL only) and groundwater	Site operations
	Cis-1,3-dichloropropylene	Soil	Site operations
	Dibromochloromethane	Soil (above DIGWSSL only)	Site operations
	Ethylbenzene	Soil (above DIGWSSL only) and groundwater	Site operations
	Isopropyl benzene	Sediment	Site operations

COC Suite	Specific COC	Impacted Media	Potential COC Source
	Methyl tert-butyl ether (MTBE)	Soil (above DIGWSSL only) and groundwater	Site operations
	Tert butyl alcohol (TBA)	Soil (above DIGWSSL only) and groundwater	Site operations
	Tetrachloroethylene (PCE)	Soil and groundwater	Site operations
	Toluene	Soil (above DIGWSSL only) and groundwater	Site operations
	Total xylene	Soil (above DIGWSSL only), sediment, and groundwater	Site operations
	Trans-1,3-dichloropropylene	Soil	Site operations
	Trichloroethylene (TCE)	Soil and groundwater	Site operations
	Vinyl chloride	Soil and groundwater	Site operations
Semi-Volatile Organic Compounds (SVOCs)	1,2-diphenylhydrazidine	Soil	Site operations
	N-nitroso-di-n-propylamine	Soil	Site operations
	Benzidine	Soil	Site operations
	2,4-dinitrotuene	Soil	Site operations
	Polycyclic aromatic hydrocarbon (PAH) compounds	Soil and groundwater	Historic fill and/or Site operations
	Naphthalene	Soil	Site operations
	2-methylnaphthalene	Soil	Site operations
	Hexachlorobenzene	Groundwater	Site operations
	1,4-dioxane	Groundwater	Site operations
Metals	Metals	Soil and groundwater	Historic fill and/or Site Operations
Polychlorinated Biphenyls (PCBs)	PCBs	Soil	Historic Fill and/or Site operations
Per- and Polyfluoroalkyl Substances (PFAS)	Perfluorooctanoic acid (PFOA)	Groundwater	Site operations
	Perfluorononanoic acid (PFNA)	Groundwater	Site operations
	Perfluorooctanesulfonic acid (PFOS)	Groundwater	Site operations
Other	Ammonia	Groundwater	Site operations

Notes:
DIGWSSL = Default Impact to Groundwater Soil Screening Level

2.2 Characterization of Groundwater Contaminant Sources

LNAPL has historically been observed in various monitoring wells at the Site and within the boundaries of the following AOCs: AOC-7, AOC-10 (Tanker Truck Loading Rack), AOC-16B (Marine Terminal Loading Rack Area), AOCs 21, 22, 23, and 24 (Advanced Waste Water Treatment Plant Area), AOC-46 (Slop Gasoline Unloading Area), AOC-53 (Second Tank Field), AOC-56 (Second Reserve Tank Field), AOC-93 (Waste Water Treatment Tankfield), AOC-94 (Oxidation Tower area), AOC-95, (Waste Water Treatment – Storage Area). **Figure 9** shows the location where LNAPL has historically been observed at the Site. The LNAPL at these locations can represent potential sources of dissolved phase groundwater contamination.

These LNAPLs are encountered in the pore spaces of the soil and fill as droplets held in place by capillary pressures resulting from its interaction with groundwater. Hydrocarbon LNAPLs that have been blended with alcohols have reduced hydrophobicity and increased potential mobility. However, the mobility of these LNAPLs is ultimately dependent on the mass of the release and the LNAPL's saturation of the pore spaces. Locations where a small mass was released results in a rapid immobilization of the LNAPL due to retentive capillary forces within the pore spaces. Larger masses released to the subsurface will normally migrate downwards until encountering the saturated zone and then will accumulate in place until buoyancy and capillary pressure impede vertical migration. The LNAPL will then begin to migrate laterally at the capillary fringe unless sufficient mass is present to displace the pore water. The LNAPL will continue to migrate laterally in the direction of groundwater flow until insufficient mass is present to displace the groundwater present in the pore spaces. The migration of NAPL in the subsurface results in a trail of residual LNAPL saturation in pore spaces that is left behind in the pathway of a migrating LNAPL. These residual LNAPLs are immobile but remain sources of dissolved groundwater contamination. This scenario represents the predominant condition observed at the Site where either limited LNAPL releases or decades old releases have occurred resulting in source areas that have been delineated and are composed of immobile and often highly weathered residual LNAPL.

The source areas have been identified and constituent pathways have been delineated as shown on **Figures 7.1** through **7.20.** These figures show the potentiometric surface which can be used to infer groundwater flow direction, the inferred upgradient contaminant source areas, and the dispersivity of the dissolved contaminants for various depth intervals corresponding to the three water bearing intervals. These maps include the delineation of benzene, TBA, MTBE, PCE, TCE, Arsenic, and Lead.

2.3 Contaminant Fate & Transport

The fate and transport of constituents of interest at the Site are dependent on a number of processes that impact contaminant travel times and concentrations. These processes include advection, dispersion, dilution, sorption, and biodegradation. Advection is the movement of constituents as a result of horizontal and vertical groundwater flow. **Figures 5.1** through **5.3** present the contoured potentiometric surface elevations of the water bearing zones and the inferred hydraulic gradients and groundwater flow directions. These figures and depictions of the groundwater flow regime from previous gauging events provide a basis for the evaluation of contaminant migration through advection processes. Advection due to horizontal groundwater flow at this Site is considered to be marginal due to the presence of small horizontal hydraulic gradients resulting in small groundwater flow velocities. Seepage velocities within the unconfined shallow groundwater bearing zone range from approximately 1.2 ft/year to 143 ft/year with a median of 15 ft/year and a mean of 31 ft/year; seepage velocities within the semi-confined intermediate water bearing zone range from 1.2 to 204 ft/year with a median of 2.5 ft/year and mean of 47 ft/year; and, seepage velocities within the deep groundwater bearing zone range from 5.5 ft/year to 30 ft/year with a median of 22 ft/year and mean of 20 ft/year.

Advection due to vertical groundwater flow is likely attenuated by the presence of the underlying clayey intervals of the Meadow Mat and glacio-lacustrine layers, where present. Although vertical hydraulic conductivity data is presently not available, values can be estimated using published values and common relationships between the ratio of vertical to horizontal hydraulic conductivity values. Spitz and Moreno (1996) indicate that the ratio of vertical to horizontal hydraulic conductivity for an interbedded sand, silt, clay, which is similar to the intervals encountered within the Meadow Mat and glacio-lacustrine layers present beneath the Site, is generally 0.1. This value is consistent with a general "rule of thumb" for the relationship between vertical and horizontal conductivities. These results predict that the vertical hydraulic conductivity values for Meadow Mat and the glacio lacustrine layer will be 0.1 to 0.3 ft/year. Unfortunately, these layers are not continuous beneath the Site and areas where sandy glacial till is generally present are areas where the Meadow Mat is absent. Spitz and Moreno (1996) also indicate that the ratio of vertical to horizontal hydraulic conductivity for layers such as the sandy glacial till may be 0.5 to 1.0 indicating that advection may be an important process for vertical migration in these areas.

Hydrodynamic dispersion is the process of contaminants spreading within and transverse to the primary groundwater flow direction. Dispersion occurs as a result of both the physical properties of the aquifer material causing changes in flow rates and directions and through diffusion processes that are driven by concentration gradients where movement occurs from high concentration areas to low concentration areas in an effort to attain equilibrium. The dispersion coefficient is typically represented as the product of the average groundwater seepage velocity and a constant term referred to as dispersivity. Dispersivity values historically used for similar sites in Coastal New Jersey have been small due to low seepage velocities and textural homogeneities of the aquifer matrix. Fate and transport models for these similar sites used values of 50 feet for longitudinal dispersivity, 1 foot for horizontal transverse dispersivity, and 1 foot for vertical transverse dispersivity.

Sorption processes attenuate the transport of contamination through adsorption and absorption. Adsorption is the process of contaminants adhering to the mineral matter of the aquifer material and absorption is the process where contaminants partition as a result of the presence of soil organic matter. The sorption processes reduce the rate of migration of constituents by a coefficient referred to as the retardation factor (R_f). The R_f is equivalent to the ratio of the groundwater velocity to the constituent transport velocity hence this value will always be equal to or greater than a value of 1.0. For example, an R_f of 2 equates to a constituent migration rate that is 2 times less than the groundwater flow velocity.

Biodegradation is the breakdown of organic constituents by microorganisms under aerobic, anaerobic, or a combination of both (cometabolic) conditions. Under aerobic conditions, the bacteria use a carbon substrate as the electron donor and oxygen as the electron acceptor. Under anaerobic degradation involves microbial methanogensis and reductive processes. Sorption and biodegradation are each mechanisms likely occurring at the Site and each attenuate the transport of Site related contaminants, as evidenced by the historical groundwater sampling results.

Evaluation of these processes and how they impact contaminant migration, attenuation, and degradation at the Site can be examined further by modeling a set of Site-specific contaminant indicator parameters through integration with a transient groundwater flow model that is calibrated to the historical potentiometric and groundwater chemistry data. This model can then be used to predict the fate and transport of Site related constituents of interest. The outcomes from a contaminant modeling effort can then be used to further refine this CSM through forecasts of attainment of plume stability and assessment of potential receptors.

3.0 SUMMARY OF IMPACTED MEDIA: SOIL

Numerous Site Investigation (SI) and Remedial Investigation (RI) activities have been completed which identified COCs on-site that require further delineation and characterization. The sources of contamination in the soil and groundwater at the Site are primarily related to historic operations, historic releases, and the presence of historic fill.

Soil COC(s)	AOCs (or adjacent AOCs) with Confirmed Soil Impacts
EPH	AOC 1, AOC 2, AOC 9, AOC 12, AOC 13, AOC 20b, AOC 21, AOC 54, AOC 56, AOC 57, AOC 88, AOC 94, and AOC 95
VOCs	AOC 1, AOC 2, AOC 8, AOC 9, AOC 10, AOC 11, AOC 13, AOC 19, AOC 25, AOC 57, AOC 77, AOC 79, AOC 86, AOC 88, AOC 110, and AOC 111
SVOCs	-Generally ubiquitous throughout Site- AOC 1, AOC 8, AOC 9, AOC 10, AOC 13, AOC 14a, AOC 14b, AOC 15b, AOC 16b, AOC 20b. AOC 22, AOC 23, AOC 24, AOC 25, AOC 26, AOC 40, AC 42, AOC 44, AOC 45, AOC 57. AOC 58, AOC 61, AOC 62, AOC 63, AOC 74, AOC 85, AOC 88, AOC 89, AOC 91, AOC 92, AOC 100, AOC 103, AOC 109, AOC 110, AOC 111, and AOC 116
PCBs	AOC 1, AOC 8, AOC 9, AOC 20b, AOC 33, AOC 63, AOC 88, and AOC 102
Metals	-Generally ubiquitous throughout Site-

As discussed in **Section 1.2**, Site History, EPH and BTEX have been determined to be the primary indicator chemicals for the vast majority of fluids handled at the Site. The following table summarizes the AOCs (or adjacent AOCs) that have confirmed soil impacts for all chemicals of concern including EPH, VOCs, SVOCs, metals, and/or PCBs above applicable NJDEP standards.

A series of “Hot Spot” figures for EPH, VOCs, SVOCs, PCBs, and metals (depicting levels which are above the corresponding NJDEP standards) are included as **Figures 6.1** through **6.5**.

4.0 SUMMARY OF IMPACTED MEDIA: GROUNDWATER

4.1 Groundwater Investigation Status

Groundwater COCs at the Site include VOCs, SVOCs, metals, Per- and Polyfluoroalkyl Substances (PFAS), and ammonia. A majority of groundwater impacts are either confined to the Site boundaries, are associated with regional background impacts (i.e., historic fill material), or have been delineated off-site (except for minor TBA groundwater exceedances along the southern Site boundary at the approximate 20-60 feet bgs depth interval as the plume migrates southeast). Further investigations are pending to complete the groundwater delineation for the Site. All groundwater COCs have been delineated vertically by several ‘deep’ monitoring wells, except for TCE, which was detected slightly above the NJDEP Groundwater Quality Standard (GWQS) in monitoring well SC-3DDD during the November 2019 groundwater sampling event. Quarterly groundwater sampling is conducted at the Site for all monitoring wells associated with the North Landfarm, South Landfarm, and No. 1 Landfarm. Annual groundwater sampling is conducted at the Site for all monitoring wells associated with AOC 3, AOC 5, AOC 10, AOC 11a, AOC 12, AOC 14a, AOC 19, the Tankfield Remediation Management Unit (TRMU), and the Former Refining Area Remediation Management Unit (FRARMU). Summaries of AOCs and remediation management units (which are defined in **Attachment A**) with groundwater impacts (other than historic fill related impacts) are as follows:

<u>AOC 2 – South Landfarm</u>

- Shallow depth (~10-15 feet bgs) impacts
  - VOCs, ammonia, and metals

<u>AOC 5 – Aeration Basins</u>

- Shallow depth (~10-15 feet bgs) impacts
  - 1,4-Dioxane, ammonia, and metals

<u>AOC 10 – Truck Loading Rack</u>

- Shallow depth (~10-15 feet bgs) impacts
  - VOCs, SVOCs, ammonia, and metals
- Shallow-intermediate depth (~25-35 feet bgs) impacts
  - VOCs, SVOCs, ammonia, and metals
- Intermediate-deep depth (50-65 feet bgs) impacts
  - VOCs, 1,4-dioxane, ammonia, and metals

<u>AOC 11a – Administration Building</u>

- Shallow depth (~10-15 feet bgs) impacts
  - VOCs, 1,4-dioxane, ammonia, and metals
- Shallow-intermediate depth (~25-35 feet bgs) impacts
  - VOCs, SVOCs, and metals
- Intermediate-deep depth (50-65 feet bgs) impacts
  - VOCs, SVOCs, and metals

AOC 12 – Detention Basin & Smith Creek

- Shallow depth (~10-15 feet bgs) impacts
  - 1,1-Dichloroethene, hexachlorobenzene, and metals
- Shallow-intermediate depth (~25-35 feet bgs) impacts
  - VOCs,1,4-dioxane, ammonia, and metals
- Intermediate-deep depth (50-65 feet bgs) impacts
  - Metals
- Deep depth (70-80 feet bgs) impacts
  - TBA, TCE, and metals

AOC 19 - QC Laboratory

- Shallow depth (~10-15 feet bgs) impacts
  - Benzene, PAHs, ammonia, and metals

AOC 103 – Fire Pits/Fire Training Areas

- Shallow depth (~10-15 feet bgs) impacts
  - PFAS compounds (Perfluorooctanesulfonic acid [PFOS], Perfluorononanoic acid [PFNA], and Perfluorooctanoic acid [PFOA]), benzene, and benzo(a)anthracene
  - Additionally, perfluorohexonoic acid, perfluoroheptanoic acid, perfluorobutanesulfonic acid, and perfluorohexanesulfonic acid were detected at significant levels in several monitoring wells, however no GWQS or Interim GWQS exists for these compounds.

Marine Dock Remediation Management Unit (MDRMU)

- Shallow depth (~10-15 feet bgs) impacts
  - Benzene, benzo(a)anthracene, and metals

Tankfield Remediation Management Unit (TRMU)

- Shallow depth (~10-15 feet bgs) impacts
  - Benzene, hexachlorobenzene, ammonia, and metals

Former Refining Area Remediation Management Unit (FRARMU)

- Shallow depth (~10-15 feet bgs) impacts
  - VOCs, SVOCs, ammonia, and metals

All information and data utilized above to summarize groundwater impacts was extracted from Quarterly Progress Reports and Remedial Investigation Workplans associated with the Site. The COCs identified in each AOC/remediation management unit will be further defined pending the completion of additional remedial investigations and the groundwater impact summaries will be updated accordingly.

4.2 Groundwater Source and Flow Discussion

According to the November 2019 groundwater sampling results (and January 2020 groundwater sampling results for PFAS compounds), the following monitoring wells have been observed to exhibit the highest concentrations of individual groundwater VOC impacts.

Groundwater COC (and GWQS)	Monitoring Well ID	COC Concentration (November 2019)	AOC Location
Benzene (1.0 µg/L)	TR-5	3,610 µg/L	AOC 10: Truck Loading Rack
MTBE (70 µg/L)	TR-3D	133,000 µg/L	AOC 10: Truck Loading Rack
PCE (1 µg/L)	AD-5	628 µg/L	AOC 11a: Administration Building
TBA (100 µg/L)	TR-3D	75,700 µg/L	AOC 10: Truck Loading Rack
TCE (1 µg/L)	TR-3D	4,880 µg/L	AOC 10: Truck Loading Rack
PFOS 0.013 µg/L)	FA-6	61.7 µg/L (PFOS)	AOC 103: Fire Pits/Fire Training Areas

Based on a review of groundwater analytical and contour elevation data, chlorinated VOCs (CVOCs, i.e., PCE and TCE) in groundwater are likely originating from the parcel occupied by AOC 11a: Administration Building, which previously housed tanks utilized by the Petroleum Solvents Corporation.

VOCs associated with potential petroleum and gasoline additive releases (i.e., TBA, benzene, and MTBE) are identified throughout the Site and are likely originating from AOC 10: Truck Loading Rack, as well as historic spill locations, former petroleum refining operations, AOC 11a: Administration Building, and product storage. During the most recent round of groundwater sampling (December 2020), benzene was detected at a concentration exceeding the GWQS in the groundwater samples collected from the AOC 5 – Aeration Basins, AOC 10 – Truck Loading Rack, AOC 11a – Administration Building, AOC 16b – Marine Terminal Loading Area, AOC 103 – Fire Fighting Training Area/Fire Pits, and the Southern Remediation Management Unit monitoring wells. Ethyl Benzene and xylenes were only detected over the GWQS in one monitoring well (AD-10, AOC-11a). Toluene wasn't detected over the GWQS in any of the groundwater samples. These analytical results are consistent with historic groundwater results for the Site.

PFAS compounds were detected at elevated levels at AOC 103: Fire Pits/Fire Training Areas and potentially may have originated from the historic use/discharge of fire foam at the Site.

Based on the spatial distribution and concentration levels, metals and PAHs are likely originating from historic fill material that has been identified throughout the Site and not petroleum discharges from Hess' operations. Groundwater monitoring will continue along with future evaluations of chemical distributions and concentrations.

Groundwater analytical and elevation data associated with co-located wells at the Site show vertical gradients are predominantly downward, as presented in **Table E-1** of **Attachment E,** which supports the presence of a feature or features that are attenuating the vertical flow of groundwater from the shallow unconfined water bearing zone to deeper intervals. Due to the stratified nature of sand, silt, and clay intervals within the Meadow Mat and underlying glacio-lacustrine units, vertical flow within these materials is likely minimal, where they are present. However, the borehole logs indicate that these units responsible for attenuating the vertical flow of groundwater and constituents are not continuous beneath the entire Site and most notably not present beneath some of the northern areas. These areas are where localized vertical contaminant migration has been observed and an example is the contaminant migration pathways associated with source areas located near the Administration Building that have resulted in the localized presence of chlorinated solvents in all three water bearing zones.

Horizontal and vertical spatial analysis of specific target VOCs have shown groundwater impacts generally following the observed groundwater flow from 'source' areas to the southeast. Possible preferential pathways, such as utility trenches and the infilled portion of Smith Creek, have also been evaluated and no anomalous groundwater impacts have been identified to date. This may be due to a combination of the small horizontal hydraulic gradients and the use of backfill that is similar in character to the existing historic fill placed on top of the Meadow Mat for the industrial development of this area. These observations continue to be validated through the examination of the groundwater potentiometric surface maps (**Figures 3, 4,** and **5**) and Groundwater Isopleth Maps which depict Site utilities and are included as **Figures 7.1** through **7.20**.

Additionally, natural VOC degradation in groundwater has been observed horizontally and vertically downgradient from potential 'source' areas via parent-daughter degradation relationships. These occurrences can be observed in the respective parent-daughter relationship between dense chlorinated solvents PCE and TCE, as well as highly soluble gasoline additives MTBE and TBA at the Site. The following examples outline the parent-daughter compound degradation relationships utilizing data from the November 2019 groundwater sampling event:

- PCE exhibited the highest concentrations in shallow (0-20 feet bgs) monitoring well AD-5, which is adjacent to AOC 11a: Administration Building, at a concentration of 628 microgram per liter (µg/L). TCE, which is a daughter compound of PCE, exhibited the highest concentrations in shallow/intermediate (20-40 feet bgs) monitoring well TR-3D at 4,880 µg/L adjacent to AOC 10: Truck Loading Rack, which is horizontally (approximately 750 feet) and vertically downgradient from monitoring well AD-5. Historical data relating to the release date versus the contaminant migration rate versus the local groundwater flow rate indicate that this plume is being significantly attenuated. These observations are consistent with the conceptual contaminant flow and degradation model for this Site. These data trends are further depicted on **Figures 7.10** and **7.14**.

- MTBE and TBA exhibited the highest concentrations in shallow/intermediate (20-40 feet bgs) monitoring well TR-3D at 133,000 µg/L and 75,700 µg/L, respectively, which is adjacent to AOC 10: Truck Loading Rack. TBA, which is a daughter compound of MTBE, exhibited significantly higher concentrations and slightly more spatial disbursement horizontally downgradient from well TR-3D (in wells PER-9D [2,670 µg/L], SC-3D [128 µg/L], PER-10D [101 µg/L], SC-4D [103 µg/L]) compared to that of MTBE (PER-3D [84.4 µg/L], PER-10D [115 µg/L], and SC-3D [95.5 µg/L]). Additionally, TBA is observed to be more persistent in deeper groundwater zones as observed in well PER-2DD, which reported TBA concentrations at 631 µg/L, while MTBE is reported below applicable standards in monitoring well PER-2DD. This observation is consistent with an assumed contaminant flow and degradation model for this Site. These data trends are further depicted on **Figures 7.5, 7.6,** and **7.8**.

4.3 Groundwater Classification Discussion

A review of the Site groundwater analytical results indicates that concentrations of several metals (manganese, sodium, and chlorides) and total dissolved solids confirm that naturally occurring chemicals have affected the shallow groundwater at the Site. Each of these compounds exceed the NJDEP Class IIA drinking water standards. The groundwater quality standards (NJAC 7:9c) allow the establishment of a Class IIB aquifer designation where "conventional water supply treatment, mixing, or other similar techniques" cannot create a potable water below the applicable groundwater quality standards. Supplemental groundwater monitoring and analytical data will provide a more extensive evaluation of the groundwater characteristics and naturally occurring chemicals beneath the Site.

5.0 POTENTIAL RECEPTORS

As outlined in the TRSR, the purpose of the Receptor Evaluation (RE) is to document the existence of human or ecological receptors and the actions taken to protect receptors. The RE includes the evaluation of four (4) potential receptors: on-site and surrounding property use, groundwater use (wells), vapor intrusion (VI), and ecological receptors, as discussed in detail below. A RE was conducted at the Site in November 2016.

5.1 On-Site and Surrounding Property Use

Land use within 200 feet of the property boundary includes residential homes. However, the closest residential property is over 800 feet from known petroleum impacts at the Site. In addition, all residences are topographically and hydraulically upgradient to the Site impacts. Multiple groundwater monitoring wells are located between the known impacts and the residences. These monitoring wells are sampled annually and there have been no COCs identified above the NJDEP GWQS.

5.2 Well Search

Based on a well search that was performed on July 31, 2019, in accordance with N.J.A.C 7:26E-1.14, there is one potentially potable well within a 0.5-mile of the Site. The potentially potable well is located approximately 2,400 feet from the known extent of contamination.

As described above, the shallow groundwater has been impacted with naturally occurring chlorides, sodium and total dissolved solids. The surrounding area is served by public water suppliers.

5.3 Vapor Intrusion Investigation

As presented on **Figure 2**, the majority of the Site is utilized for petroleum storage or historic petroleum refining operations. The Administrative Building is one of the few structures which is routinely occupied. Three (3) vapor intrusion investigations have been conducted at the Site in June 2007, November 2010, and July 2020 at the Administration Building located in the western portion of the Site.

The June 2007 indoor air investigation analytical results reported two (2) VOCs (benzene and methylene chloride) above the NJDEP Non-Residential Indoor Air Screening Level (NRIASL) on the first floor of the building. However, it was reported that these exceedances were attributed to background contaminant sources, including designated smoking areas adjacent to the building, air fresheners, perfumes, and/or the commercially cleaned floor mats. In addition, chloroethane was detected above the NRIASL in a basement indoor air sample, however no sub-slab soil gas samples were collected from beneath the basement floor during the initial air screening investigation. Without subslab data it could not be determined if there was a complete pathway between the soil gas and the indoor air for the origin of the chloroethane presence.

In November 2010, a second vapor intrusion investigation, consisting of sub-slab soil gas and indoor air samples, was conducted at the Site Administration Building. The analytical results of the sub-slab soil gas samples indicated that chloroform, 1,1-dichloroethane, and p-dichlorobenzene were present in the sub-slab above the NJDEP Non-Residential Soil Gas Screening Levels (NRSGSL). All indoor analytical results were reported below the NJDEP Indoor Air Screening Levels (IASL), thus confirming that there is no complete pathway between the soil gas and the indoor air.

On July 23, 2020, a third vapor intrusion investigation, consisting of indoor air and ambient air samples, was conducted at the Site Administration Building. The analytical results of the samples reported all targeted compounds below applicable NJDEP IASL and Rapid Action Levels (RALs).

5.4 Ecological Evaluation

Pursuant to Chapter 7:26E-1.16 of the NJDEP TRSR an Ecological Evaluation (EE) was conducted as part of the SI activities. The preliminary results from the EE have indicated that environmentally sensitive areas, such as those described in N.J.A.C. 7:26E-3.6 and 4.8, are present at the Site and contaminant migration pathways to environmentally sensitive areas also do exist. The EE at the Site is ongoing and has identified EPH and VOC impacts within the Detention Basin sediment. The source of the sediment impacts likely originates from historic petroleum releases associated with stormwater collection from the Site aboveground storage tanks (ASTs). A summary of the previously conducted EE investigations, which have been focused on AOC 12: Smith Creek and Detention Basin, are summarized below.

In November 2018, sediment and surface water samples were collected from the Detention Basin. Based on an evaluation of the surface water and sediment analytical results, no impacts were identified in the surface water samples collected from the Detention Basin. However, EPH and VOCs (benzene, carbon disulfide, total xylene, and isopropyl benzene) were identified in the Detention Basin sediment.

In February and March 2019, sediment and surface water samples were collected from Smith Creek and Smith Creek Pond. Based on an evaluation of the surface water and sediment analytical results for Smith Creek and Smith Creek Pond; it was determined that impacts due to historic operations or releases was not evident.

A formal delineation of Site wetlands, including the Detention Basin area, is forthcoming. Partial Site wetland delineation has been conducted in the northern portion of the Site and is further summarized in **Section 1.3.2** and **Attachment G**. The Sitewide delineation effort will provide the necessary information for mapping the geographic limits of the basin wetlands. The delineation will be conducted pursuant to policy set forth under the New Jersey Freshwater Wetlands Protection Act (FPWA, N.J.S.A. 13:9B-1 et seq.).

To further characterize the presence of Site constituents of potential environmental concern (COPECs) and potential groundwater to surface water pathways, groundwater analytical data in the portions of the Site adjacent to the Ecologically Sensitive Natural Resources (ESNRs), including the southern portion of the Site adjacent to the Detention Basin, the eastern portion of the Site adjacent to the Arthur Kill, the northern portion of the Site adjacent to the North Drainage Ditch, and any portion of the Site identified to be adjacent to wetlands shall be assessed for the following (as per the NJDEP Characterization of Contaminated Groundwater Discharge to Surface Water Technical Guidance, Version 1.0, January 2016):

- The distance from the location of ground water impacts to the surface water body;
- The velocity and direction of ground water and COPEC flow;
- The estimated length of time that ground water impacts have been migrating; and
- Preferential flow paths.

An EE Workplan is in the process of being formulated/implemented at the Site to provide a more comprehensive evaluation of potential ecological impacts at the Site and will be included in forthcoming remedial phase reports. The objective of the investigation will be to sufficiently characterize the contaminated ground water discharge zone(s) and determine if the groundwater contaminant migration pathway to surface water is complete. Groundwater from monitoring wells adjacent to surface waters will be compared to the current NJDEP Surface Water Quality Standards (SWQS) to isolate and characterize specific COPECs that may pose an Ecological risk to surface waterbodies.

6.0 INTERIM REMEDIAL MEASURES

6.1 LNAPL and Sheen Management

Currently, monitoring wells are gauged on a bimonthly basis to evaluate the presence and extent of LNAPL at the Site. Passive LNAPL recovery efforts and scheduled vacuum extraction events are being utilized at the Site to manage LNAPL and associated sheens. Passive LNAPL and sheen recovery events include the use of absorbent socks that are placed in impacted wells and replaced as necessary. All spent absorbent socks that are saturated with LNAPL and sheen are placed in a 55-gallon drum staged on-site. Once at capacity, the drum is removed and disposed of at a licensed waste disposal facility.

Gauging data for the last 5 years has been reviewed and indicates that measurable product over 1 foot has been detected in monitoring well PL-5/PL-5R during the 2018 gauging events only. A table summarizing historic gauged LNAPL levels is included in **Attachment F**. No significant levels of LNAPL have been detected in Site monitoring wells during the 2015, 2016, 2017, 2019, and 2020 gauging events.

An interceptor trench is present within AOC 10, the Truck Loading Rack. This interceptor trench consists of a shallow collection trench oriented perpendicular to the direction of LNAPL migration that has been backfilled with high permeability crushed stone. A low permeability membrane is present on the downgradient side of the trench wall that intersects the water table and acts as a barrier to the horizontal migration of LNAPL while allowing groundwater to flow beneath it. Recovery of the LNAPL from the interceptor trench is performed via vacuum recovery through a series of sumps. Vacuum extraction events are continually conducted on an as-needed basis for petroleum impacted water and LNAPL from the interceptor trench and monitoring well PL-5R. Liquids collected during these recovery events are transported off-site for treatment and disposal at a licensed waste disposal facility. A summary of the LNAPL and groundwater recovered during the various vacuum extraction events from 2016 through 2020 is provided in **Attachment F**. Additional delineation of known LNAPL impacted areas will be addressed in future work plans and the CSM updated accordingly.

Given the refinery operation processed up to 70,000 bbls of oil per day (~2.9 million of gallons of daily throughput), potentially 5.8 million gallons of hydrocarbon fluids were managed every day at the facility for several years. **Figure 9** presents the monitoring well locations where LNAPL has been detected over the past 5 years. The figure demonstrates LNAPL is isolated to select monitoring wells across the Site and exist within approximately five (5) isolated footprints. Additional investigations to delineate, characterize and remediate the LNAPL will continue as each LNAPL area appears to be isolated from the other areas.

7.0 ANTICIPATED REMEDIAL SELECTION

COCs remain in groundwater and soils at concentrations above current applicable NJDEP standards. Delineation of the soil and groundwater COCs on and/or migrating from the Site is ongoing. Once delineation is complete, the remedial action strategy for the Site may include a combination of source removal (hot spot excavations), in situ treatment, and the use of both institutional and engineering controls. Ongoing monitoring of Site institutional and engineering controls will be conducted as part of the NJDEP Soil and Groundwater Remedial Action Permit (RAP) Biennial Certification process. The remedial action strategy for Site AOCs will continue to be evaluated and revised, if necessary, as new analytical results and site information become available. Another factor that could influence or require changes to the remedial action strategy is the Natural Resource Damages suit filed by the NJDEP on August 1, 2018, particularly as to restoration. Therefore, the proposed remedial actions summarized in this section should be considered preliminary at this time.

7.1 Soil Remediation

Soil sampling has been conducted at the Site and has documented the presence of historic fill material related compounds (metals, PAHs), as well as the presence of impacts pertaining to historic operations and releases (SVOCs, VOCs, select metals, and EPH). A Sitewide historic fill investigation is in process and the results will be included in forthcoming remedial phase reports.

7.1.1 Ex-Situ and/or In Situ Treatment

Ex-situ (soil excavations) and/or in situ treatment may be utilized to address isolated areas of soil impacts with concentrations above the NRDCSRS. The final soil remedial action is to be determined and will be presented in a Remedial Action Workplan (RAW) that will be submitted to the NJDEP prior to implementation.

7.1.2 Institutional Control (Deed Notice)

To address the soil impacts at the Site to be left in place at concentrations in excess of the RDCSRS and NRDCSRS, an institutional control (i.e., Deed Notice) will be implemented for the Site.

7.1.3 Engineering Control (Cap)

The Site is approximately 223 acres and is generally covered by asphalt blacktop, degraded asphalt or millings, gravel, concrete slabs, buildings, vegetation, exposed soil, and ASTs. A Sitewide Surface Map is included as **Figure 8**. To prevent direct contact with impacted media remaining on the Site, the buildings, ASTs, concrete pads, gravel, vegetation, and existing asphalt pavement (deemed to be in acceptable condition) will remain in place and will be maintained as a part of the engineering cap. Areas of the Site with surficial soil impacts that exceed the NRDCSRS that are currently either uncapped, or deemed to have an unacceptable surface condition, will be addressed prior to establishing the Soil RAP.

As per federal regulatory requirements, the Site landfarm units (No. 1, North, and South) will be capped per Resource Conservation and Recovery Act (RCRA) requirements. The following presents the current remediation stage for each of the landfarm units:

- No. 1 Landfarm – 100% Remedial Action Design (RAD) Report is approved, Construction Permitting is in progress

- North Landfarm – Finalization of the 100% RAD Report
- South Landfarm – Initiating the 90% RAD Report

Inspections will be conducted on a regular basis in order to assess the integrity of the engineering controls. The inspections will be summarized as part of the Biennial Certifications, and any alterations, improvements, and disturbances will be documented and addressed as per NJDEP requirements.

7.1.4 Soil Remedial Action Permit

Earth Systems will complete and submit to the NJDEP a RAP for Soil, which is required whenever a remedial action includes leaving soil impacts in place at concentrations in excess of the RDCSRS. As per current NJDEP requirements for monitoring the protectiveness of institutional and engineering controls (i.e., the Deed Notice and cap), a Biennial Certification will be submitted every two (2) years, subsequent to the approval of the RAP. The Biennial Certification will be prepared in accordance with NJDEP guidance and/or forms in effect at the time of the submittal of the Biennial Certification.

7.2 Groundwater Remediation

Extensive groundwater sampling has been conducted at the Site and has documented the presence of impacts related to historic operations, historic releases, and the presence of historic fill material. Groundwater investigation activities are currently ongoing. Once groundwater impacts are fully delineated, the various groundwater remedial options will be evaluated.

7.2.1 In-Situ Remediation

In-situ remedial options to address groundwater impacts at the Site are currently under review. Specifically, remediation of VOCs associated with the Truck Loading Rack and Administration Building AOCs in the west and southwest portions of the Site may be required. The final groundwater remedial action is to be determined and will be presented in a RAW that will be submitted to the NJDEP prior to implementation.

7.2.2 Sheen/LNAPL Management

According to the 2006 NJDEP Sheen Remediation Policy Memo, "if a continuous sheen is present on the water table in any well or excavation associated with the area of concern, additional remediation will be required." Once delineation is complete in known LNAPL impacted areas, source removal and/or in situ treatment options will be evaluated as potential remedial options.

As described in **Section 6.1**, the total volume of LNAPL atop the shallow groundwater appears to be small and spatially isolated. Groundwater analytical data shall be used in combination with direct monitoring for LNAPL and the NJDEP sheen policy to characterize the nature and extent of LNAPL beneath the Site.

7.2.3 Monitored Natural Attenuation (MNA)

MNA is a remedial action that relies on the natural attenuation processes to achieve the applicable groundwater remediation standard. Natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in groundwater (NJDEP MNA Technical Guidance, March 1, 2012).

MNA will be instituted after active remediation has been conducted, and it has been determined that a significant amount of source material has been removed from the Site. The proposed MNA groundwater remedy is protective of human health and the environment for the following reasons:

- Delineation of the groundwater COCs is complete, and the immobility of the COCs to migrate down-gradient off-site is not a concern.
- No receptors are impacted or threatened (e.g., potable wells, wellhead protection areas, surface water, vapor intrusion to indoor air, utilities).

7.2.4 Classification Exception Area/Well Restriction Area

A Classification Exception Area (CEA) / Well Restriction Area (WRA) is an institutional control that the NJDEP uses to restrict the use of groundwater within an area where groundwater impacts exceed the applicable GWQS. Two (2) CEA/WRAs will likely be submitted to the NJDEP to document the Site-wide groundwater impacts as follows:

- One (1) CEA/WRA/Virtual Institutional Control (VIC) for historic fill material (PAHs and metals) that encompasses the entire footprint of the Site.
- One (1) CEA/WRA for several VOCs, SVOCs, ammonia, and PFAS compounds that will encompass distinct portions of the Site based on further plume characterization.

7.2.5 Groundwater Remedial Action Permit

At the completion of groundwater delineation and remediation activities, Earth Systems will complete and submit to the NJDEP a RAP for Groundwater, which will most likely propose active remediation (ex-situ and/or in-situ) and Monitored Natural Attenuation (MNA) for the degradation of VOCs, SVOCs, PFAS compounds, and ammonia. In addition, the RAP will also address historic fill related groundwater impacts (metals and PAHs). As per current NJDEP requirements for monitoring the protectiveness of an institutional control (i.e., the CEA/WRA), a Biennial Certification will be submitted every two (2) years, subsequent to the approval of the RAP. The Biennial Certification will be prepared in accordance with NJDEP guidance and/or forms in effect at the time of the submittal of the Biennial Certification. Site-wide groundwater sampling will be conducted regularly for the duration of the CEA/WRA.

7.3 Response Action Outcome

Based on the historic analytical data, a Restricted Use Response Action Outcome (RAO) for the Site is expected to be proposed for both soil and groundwater after all necessary remediation activities have been completed. In accordance with NJDEP guidance, a Restricted Use RAO may be issued by a Licensed Site Remediation Professional (LSRP) under the following conditions:

- *Restricted Use RAO*: A Deed Notice (for exceedances of NRDCSRS) and a CEA (for exceedances of groundwater remediation standards) is required.

Attachment A

List of Areas of Concern (AOCs), Remediation Management Units & Grouped AOCs

Attachment A

Hess Corporation – Former Port Reading Complex (HC-PR)
750 Cliff Road, Port Reading, Middlesex County, New Jersey
NJDEP SRP PI # 006148
NJDEP ISRA Case # E20130449
EPA ID # NJD0454454863

AOCs

- Historical AOC-1 – North Landfarm
- Historical AOC-2 – South Landfarm
- Historical AOC-3 – No. 1 Landfarm
- Historical AOC-4 – Dredge Spoils
- Historical AOC-5 – Aeration Basins
- Historical AOC-6 – HSWA USTs
- Historical AOC-7 – Central Colonial Pipeline
- Historical AOC-8 – Waste Container Storage Area
- Historical AOC-9 – Alkylation Unit (Sewer Line)
- Historical AOC-10 – Truck Loading Rack
- Historical AOC-11a – Administration Building
- Historical AOC-11b – Former Training Center
- Historical AOC-12 – Smith Creek and Detention Basin
- Historical AOC-13 – Former Oil Water Lagoons
- Historic AOC-14a – First Tankfield;
- Historic AOC-15b – Former UST Area (USTs 0008 and 0009);
- Historic AOC-15c – Former UST Area (UST 0004);
- Historic AOC-16b – Marine Terminal Loading Rack Area;
- AOC-20a – T1600-A and T1600-B Transformers;
- AOC-20b – T510-A and T510-B Transformers;
- AOC-20c – T2606-A and T2606-B Transformers;
- AOC-21 – X-1933 (Adsorber Feed Sump);
- AOC-22 – X-1908 (Clarifier Lift Sump);
- AOC-23 – X-1904 (Storm Water Transfer Pump), S-1922 (Storm Water Corrugated Plate Separator), and
- X-1903 (Storm Water Diversion Manhole);
- AOC-24 – Sluice Pit;
- AOC-25 – X-1950A and X-1950B (Alkylation Neutralization Basin);
- AOC-26 – D-1104 (MEA Sump);
- AOC-27 – EADC Disposal Pit;
- AOC-28 – Cooling Water Tower;
- AOC-30 – Sulfur Pit;
- AOC-32 – X-1951 (SRU Neutralization Basin);
- AOC-33 – Truck Rack Sump 2;
- AOC-34 - X-1930 (Surge Pumping Station), X-1932 (API Splitter Box), X-1922A and X-1922B (API
- Separator), X-1926 (Stormwater Lagoon Sump), X-1924 (API Separator Oil Sump), S-1921A and S-
- 1921B (Process Water Corrugated Plate Separator), X-1925 (API Separator Sump), API Truck Loading

- Area;
- AOC-35 – No. 1 Landfarm Discharge Sumps;
- AOC-38 – Former Ammonia Truck Loading Rack;
- AOC-40 – Fresh Acid Unloading Area;
- AOC-43 – Truck Unloading (Prover Truck) Area 1;
- AOC-44 – Truck Unloading (Prover Truck) Area 2;
- AOC-45 – Former Sulfur Recovery Unit Truck Loading Rack;
- AOC-46 – Slop Gasoline Unloading Area;
- AOC-47 – Bleach Truck Unloading Area;
- AOC-48 – Former Equipment Fuel AST;
- AOC-49 – Electrician Shop Diesel/No. 2 Fuel Oil ASTs;
- AOC-50 – Refinery Warehouse Diesel/No. 2 Fuel Oil ASTs;
- AOC-52 – TK-7925;
- AOC-53 – Second Tankfield;
- AOC-55 – Fourth Tankfield;
- AOC-56 – Second Reserve Tankfield;
- AOC-57 – Day Tankfield;
- AOC-58 – Former Chemical Storage Area;
- AOC-59 – API Storage Area;
- AOC-60 – Avenue D Tankfield;
- AOC-62 – Inactive Railroad Spur (between Canning Plant and QC Lab);
- AOC-63 – Former Rail Lines (Vacant Land North);
- AOC-64 – Inactive Railroad Spur (Administration Building);
- AOC-73 – TEL Building (North);
- AOC-74 – TEL Building (South);
- AOC-75 – Former Canning Plant AST;
- AOC-77 – Former Petroleum Solvents AST;
- AOC-80 – Former Crude Topping Unit;
- AOC-82 – Former Incinerator Building;
- AOC-84 – Former Tank North of Administration Building;
- AOC-85 – Marine Vapor Recovery Unit (VRU) – TK-4701 and TK-4801;
- AOC-86 – Truck Rack Vapor Recovery Unit (VRU);
- AOC-87 – Flare Knock Out Drum;
- AOC-88 – Compressor Building;
- AOC-89 – Cracking Tower;
- AOC-90 – Drum Compound (QC Lot);
- AOC-92 – TK-701A and TK-701B;
- AOC-96 – Boiler Area;
- AOC-99 – Chemical Storage Adjacent to Cooling Water Tower;
- AOC-100 – Laydown Yard;
- AOC-102 – Vacant Land (South);
- AOC-103 – Fire Pits/Fire Areas;
- AOC-107 – Drum Storage Compound;
- AOC-116 – Diesel Powered Emergency Generator – South Dock; and
- AOC-117 – Diesel Powered Emergency Generator – Millright's Shop

Remediation Management Units & Grouped AOCs (by Site Location)

- Tankfields Remediation Management Unit (TRMU)

- Southern Remediation Management Unit (SRMU)

- Former Refining Area Remediation Management Unit
  - AOC-9 Alkylation Unit (Sewer Line)
  - AOC-18 Dimersol Unit
  - AOC-20a T1600-A and T-1600B Transformers
  - AOC-20b T510-A and T510-B Transformers
  - AOC-25 X-1950A and X-1950B (Alkylation Neutralization Basin
  - AOC-26 D-1104 (MEA Sump)
  - AOC-27 EADC Sump
  - AOC 28 – Cooling Water Tower
  - AOC-30 Sulfur Pit
  - AOC 31 – Brine Pit
  - AOC-32 X-1951 (SRU Neutralization Basin)
  - AOC 38 – NH3 Truck Loading Rack/Ammonia Area
  - AOC-39 EADC Truck Unloading Area
  - AOC- 40 Fresh Acid Unloading Area
  - AOC-45 Former Sulfur Recovery Unit Truck Loading Rack
  - AOC 47 – Bleach Truck Unloading Area
  - AOC-58 Former Chemical Storage Area
  - AOC 59 – API Storage Area
  - AOC-60 Avenue B Tank Field
  - AOC-80 Former Crude Topping Unit
  - AOC-88 Compressor Building
  - AOC-89 Cracking Tower
  - AOC-92 TK-701A and TK-701B
  - AOC 96 – Boiler Area
  - AOC 99 – Chemical Storage Area
  - AOC-117 Diesel Powered Emergency Generator - Millwright's Shop

- Marine Dock Area
  - AOC 16b – Marine Terminal Loading Rack Area
  - AOC 51 – Second Reserve Boiler AST Area
  - AOC 63 – Former Rail Lines (Vacant Land North)
  - AOC 81 – Former Marine Terminal Building
  - AOC 85 – Marine VRU/TK-4701 and TK-4801
  - AOC 91 – North Dock Yard
  - AOC 100 – Laydown Yard
  - AOC 102 – Vacant Land (South)
  - AOC 103 – Fire Pits/Fire Training Area
  - AOC 105 – North/South Docks
  - AOC 115 – Diesel Powered Pump
  - AOC 116 – Diesel Powered Emergency Generator – South Dock

- Tankfields
  - AOC 6 - HSWA UST
  - AOC 14a - First Tank Field
  - AOC 14b – Rundown Tankfield
  - AOC 15a, 15b, & 15c - Former UST Areas
  - AOC 37 - No. 2 Oil Detergent and Additive Truck Unloading Area
  - AOC 46 – Slop Gasoline Unloading Area
  - AOC 53 - Second Tank Field
  - AOC 54 - Third Tank Field
  - AOC 55 - Fourth Tank Field
  - AOC 56 - Second Reserve Tank Field
  - AOC 113 - Second Reserve Tank Field Oil/Water Separator

- Truck Loading Rack Area
  - AOC 10 Truck Loading Rack
  - AOC 29 – Mixing Basin
  - AOC 33 – Truck Rack Sump 2
  - AOC 43 – Truck Unloading Area 1
  - AOC 57 – Day Tankfield
  - AOC 82 – Former Incinerator Building
  - AOC 86 – Truck Rack Vapor Recovery Unit
  - AOC 109 – Truck Rack Sump
  - AOC 110 – Oil/Water Separator
  - AOC 111 – Chemical Storage Area

Attachment B

Historic Spill Summary
Table and Figure

Attachment B
Summary of Historic Spills
Hess Corporation- Former Port Reading Complex
750 Cliff Road
Port Reading, Middlesex County, New Jersey

Date of Discharge	NJDEP Case Number	Site Plan ID	Overiding Investigation	Location/ Source	Material/ Amount Released	Description of Incident	Steps Taken to Reduce/ Eliminate Release
10/30/1969	N/A	HS-1	AOC -12	Former AST in Third Tankfield	8,000,000-gallons of crude oil	Tank Failure	Formation of detention pond
8/5/1988	N/A	HS-2(A)	TFMU	Gas line release adjacent to Tank 7934	Approximately 500-gallons of gasoline	A line, thought to have been empty, was opened allowing gasoline to flow out.	Area was contained, vacuum truck mobilized to the site for cleanup.
4/25/1990	90-0425-0021	HS-2(B)	TFMU	Leak from bottom plate weld seam of Tank 7934	Approximately 840 - 1,680 gallons of gasoline	Corrosion of a bottom plate weld seam caused unleaded gasoline to leak from Tank 7934	The tank rests on a concrete base, preventing vertical migration of product. Absorbent material was placed around the tank bottom/ concrete base to contain and collect product. The tank was emptied by pumping remaining product into a nearby tank. Portions of steel floor plates were replaced and bottom inner walls coated with epoxy paint to prevent corrosion. Groundwater sampling was conducted.
1/28/1991	91-1-28-1002-17	HS-3	AOC-11	Frozen drain valve on tank at Administration Building	10 - 50 gallons of No. 2 fuel oil	No.2 fuel oil used to heat the administration building was stored in three 500-gallon ASTs. Water collected in a drain valve on the south tank and froze. As temperatures rose, the ice melted and oil leaked onto the ground and into a drainage ditch by the Conrail Tracks.	A vacuum truck was dispatched to cleanup the spill. Absorbent pads were also used. The valve was replaced and containment for the tanks was installed.
9/25/1991	91-9-25-1014-00	HS-4(A)	SRMU	API Separator overflow into Smith Creek	Approximately 500 - 700 gallons of light oil	As a result of heavy rainfall, the API separator overflowed. Light oil flowed into Smith Creek. Oil was contained and no navigable waters were affected.	Flow of oil was diked with sand and a spill boom was deployed. Saturated sweep material containment area was erected. Vacuum trucks from Hess and Ken's Marina were dispatched to site for cleanup. Health Department was contacted and was satisfied with the cleanup.
11/1/2007	07-11-01-1625-32	HS-4(B)	SRMU	Soil near API Separator	Approximately 2-gallons of oil	An oily discolored soil was encountered near the API oil/water separator during November 1, 2007 excavation activities.	Approximately 15 yards of petroleum impacted soil was transported to Cycle Chem of Elizabeth, New Jersey for proper disposal. EnviroTrac collected one soil sample from approximately 6.0 fbg. The sample was below the most stringent NJDEP SCC.
1/17/1992	92-1-17-1447-31	HS-5(A)	TFMU	Tank 1220 overfill	Approximately 1,260-gallons of catfeed	Main overfill gauge indicated a "high high" alarm but gauge failed on Tank 1220 during transfer operations from the C/T NY. Catfeed released to secondary containment area.	Containment actions were implemented at Tank 1220 to minimize area potentially impacted by the release. Approximately 340-yards of impacted soils were disposed of at an approved treatment facility.
4/26/1994	94-4-26-1139-52	HS-5(B)	TFMU	Leak from weld on Tank 1220	Approximately 84-gallons of catfeed	Apparent corrosion of a small section of the storage tank floor to shell weld resulted in a discharge of feedstock to the tankfield secondary containment area. The discharged product minimally penetrated the containment soils.	Water was pumped into the storage tank to float the product above the corrosion area and terminate the discharge. The contents of the tank were transferred to another tank. The affected soils were removed and disposed of at an approved treatment facility.

Attachment B
Summary of Historic Spills
Hess Corporation- Former Port Reading Complex
750 Cliff Road
Port Reading, Middlesex County, New Jersey

Date of Discharge	NJDEP Case Number	Site Plan ID	Overiding Investigation	Location/ Source	Material/ Amount Released	Description of Incident	Steps Taken to Reduce/ Eliminate Release
6/3/1992	92-6-3-1318-27	HS-6	HS-6	Leak from recovered oil line at Tank 7904	40 - 50 gallons of FCCU feedstock and No. 2 fuel oil	The recovered oil line was inadvertently isolated from thermal/ pressure relief protection. The oil in the line was heated by steam tracing, resulting in a buildup of pressure on the line causing flange leakage and line failure.	A vacuum truck was dispatched to pump out the recovered oil line and stop the discharge. Approximately 20 yards of crushed stone was collected and disposed of at an approved treatment facility. The line was inspected and repaired as needed.
10/28/1992	92-10-28-1052-59	HS-7	AOC-9	Corrosion of process sewer line at Alkylation Unit	Undetermined	During a video inspection of all sewer systems, corrosion of concrete sewer box was observed. This may have resulted in past discharges to surrounding soils.	Use of this section of the affected sewer system was discontinued, affected areas repaired/replaced as needed.
4/30/1993	93-4-30-1638-14	HS-8	AOC-10	Leak from bottom of Tank 1176	Approximately 84-gallons of No. 2 fuel oil	Corrosion of Tank 1176 floor plates resulted in stored No. 2 fuel oil seeping out of tank between concrete support base ring and bottom sketch plate of storage tank.	The tank was isolated and 6-inches of water was pumped into the tank to float the product and to stop it from discharging. The tank contents were transferred to another tank, tank was taken out of service until repairs could be completed.
8/23/1993	93-08-23-0952-57	HS-9(A)	AOC-14B	Leak from transfer pipe adjacent to Tank 7914	Approximately 20-gallons of light cycle oil	Corrosion of aboveground insulated product pipe resulted in a pinsize hole, and the release of a clean oil product to the tankfield secondary containment area.	The affected area of the pipe was isolated, terminating the discharge. One 20-foot section pipe was replaced and hydrotested prior to recommissioning.
10/3/1994	94-10-03-0819-31	HS-9(B)	AOC-14B	Leak from transfer pipe adjacent to Tank 7914	25-gallons of recovered oil	Recovered oil leaked from a corroded section of 3-inch diameter aboveground insulated transfer pipe near Tank 7914	The leaking pipe section was isolated, terminating the product release. A vacuum truck was used to remove residual petroleum from the pipe. Affected soils were removed and disposed of at an approved treatment facility. Approximately one 30-foot section of pipe was replaced and hydrotested prior to recommissioning.
3/18/1995	95-03-18-1523-41 (a.k.a. 95-03-18-1523-44)	HS-9(C)	AOC-14B	Leak from slurry oil transfer line adjacent to Tank 7914	Approximately 50 - 100 gallons of slurry oil	An 8-inch diameter aboveground slurry oil transfer line cracked between two 45° stub-out flanges spraying slurry oil onto the secondary containment wall and the shell of Tank 7914. The oil in the line was heated by steam tracing, resulting in a buildup of pressure on the line causing line failure.	The pipe section was isolated and steam tracing was secured once the discharge was discovered. Impacted soils, crushed stone, and absorbent material was removed and disposed of at an approved treatment facility. One 12-foot section of transfer pipe was replaced, eliminating the 45° stub-outs. Each pressure relief valve on the slurry oil transfer line was inspected and either cleaned or replaced if plugged.
10/21/1993	93-10-21-1435-21	HS-10(A)	AOC-10	Leak from product transfer pipe at the Truck Loading Rack Area	Approximately 255-gallons of gasoline	After a heavy rainfall, gasoline was detected on a concrete turnaround area at the facility truck loading rack. A inspection of the oily water sewer box in the vicinity indicated that a mixture of gasoline and water drained into the sewer box from the subsurface.	Gasoline transfer was discontinued and the affected pipe section isolated. A vacuum truck was used at the sewer box while cleanup of the gasoline on the concrete surface was completed. No surface water was impacted, and there was no off-site impact.

Attachment B

Summary of Historic Spills

Hess Corporation- Former Port Reading Complex

750 Cliff Road

Port Reading, Middlesex County, New Jersey

Date of Discharge	NJDEP Case Number	Site Plan ID	Overiding Investigation	Location/ Source	Material/ Amount Released	Description of Incident	Steps Taken to Reduce/ Eliminate Release
5/25/2006	06-05-25-1243-17	HS-10(B)	AOC-11	Fuel line from diesel pump	Approximately 1-gallon of diesel fuel	A fuel line from a diesel pump cracked causing a spill.	The spill was cleaned up and the pump line was repaired.
1/28/1994	94-01-28-0737-38	HS-11	TFMU	Leak from floating roof drain of Tank 1218	1,000-gallons of gasoline	During heavy rainfall, the roof drain valve was open, as per operating procedures, preventing the accumulation of water which could sink the roof. 2 - 3 roof drain swivel joints failed, allowing stored product to enter the roof drainpipe and drain to the tankfield secondary area.	The tankfield secondary containment area was ice covered and contained several inches of accumulated rainwater at the time of discharge. Product floating on the contained water was recovered using a vacuum truck.
3/7/1995	95-03-07-0055-00	HS-12(A)	AOC-14B	Leak from skimmer oil transfer line from process water storage Tank 7908	Approximately 100-gallons of recovered oil	Corrosion of 2-inch diameter aboveground oil skimmer transfer line from a process water storage tank resulted in a discharge of recovered oil to the tankfield secondary containment area.	The leaking pipe section was isolated, terminating the product release. A vacuum truck was used to remove residual petroleum from the pipe. Affected soils were removed and disposed of at an approved treatment facility. Approximately one 30-foot section of pipe was replaced and hydrotested prior to recommissioning.
10/10/1997	97-10-10-2359-11	HS-12(B)	AOC-14B	Catfeed pump fire	Undetermined amount of catfeed oil	A fire was detected in the facility's main catfeed/ charge pump. The feed was terminated and the fire extinguished. An inspection of the fire site revealed a minor spillage of oil into the pump pad containment area.	All liquid was quickly cleaned up from the containment area and transferred to the facility slop oil tank for eventual processing. Generated oil and debris were disposed of at an approved treatment facility.
11/7/1997	97-11-7-1647-16	HS-13	AOC-10	Discharge from Rack VRU vent pipe to VRU containment area.	Approximately 50-gallons of gasoline	Liquid gasoline was observed being discharged from the Port Reading Rack VRU vent pipe. The VRU was shut down and the discharged ended. An inspection of the spill site immediately afterward revealed a discharge of gasoline into the VRU containment area.	All liquid gasoline was quickly cleaned up from the containment area and transferred to the facility slop oil tank for eventual reprocessing, All contaminated soil and debris recovered were disposed of at an approved treatment facility.
4/2/1998	98-04-02-0944-48	HS-14	HS-14 (constituents to be investigated under SRMU)	Wastewater transferred to secondary containment system adjacent to Tank 1911	Approximately 100,000-gallons of wastewater	Excess wastewater from the refinery's wastewater equalization tank, Tank 1911, was temporarily transferred to the adjacent secondary containment system. This measure was taken to avoid overflowing and damaging the tank.	The wastewater was pumped back into the Tank 1911 once tank space became available.
5/14/2000	00-05-14-2106-28	HS-15	SRMU	Release from wastewater treatment system sump to former Aeration Basin containment area.	Approximately 50-gallons of petroleum impacted wastewater	During a routine inspection, the wastewater operator identified that the lift sump X-1908 was overflowing. The re-circulation water was shut off immediately.	A vacuum truck was dispatched to enhance free product recovery. A shallow trench along the fence line was installed. All water and product that entered the trench was recovered using a vacuum truck. All impacted soil was disposed of at an approved treatment facility.

Attachment B
Summary of Historic Spills
Hess Corporation- Former Port Reading Complex
750 Cliff Road
Port Reading, Middlesex County, New Jersey

Date of Discharge	NJDEP Case Number	Site Plan ID	Overiding Investigation	Location/ Source	Material/ Amount Released	Description of Incident	Steps Taken to Reduce/ Eliminate Release
5/28/2002	02-05-28-1640-14	HS-16	HS-16	Tank 1210 overfill	Approximately 420-gallons of Algerian Resid (FCCU feedstock)	While receiving a shipment of Algerian Resid from vessel M/V Corcovado, an overflow occurred through the gauging hatch of the tank. The spilled oil was contained within the secondary containment system of Tank 1210.	Absorbent material was immediately deployed to consolidate area. Free product was removed by a vacuum truck. Stained stone and soil was removed and disposed of at an approved treatment facility. Closure requested 6/21/2002, no response to date.
6/16/2003	03-06-16-1258-24	HS-17	SRMU	Transfer pipeline leak	Approximately 210-gallons of gasoline, at 3 Separate locations	Premium gasoline at three locations along transfer pipeline. Release occurred at 1 blind flange (126 gallons) and 2 bleeder valves (42 gallons x 2).	Transfer shutdown immediately upon discovery. Contaminated stone and soil was removed areas, locations then flooded with water to float any residual product and then recovered by tanker truck. An approximate 10 gallons was recovered from sewer by vacuum tankertruck. Vertical migration inhibited by underlying clay layer. Approximately 60 yds of contaminated soil were removed for disposal
3/9/2007	07-03-09-1437-52	HS-18	TFMU	Tank 1219	Approximately 26,000-gallons of gasoline blend stock (heavey cat Naptha)	Two water draw valves were left open on a bulk storage container causing the spill.	The spill was contained to the secondary containment area. Impacted soils around Tank 1219 were excavated and disposed of ant an approved treatment facility. Mildly impacted soils were left in place within piping trench located between Tank 1219 and 1215.
5/11/2007	07-05-11-1330-47	HS-19	AOC-9	Leaking sulfuric acid drain pipe	Unknown amount of sulfuric acid	In May 2007, a leaking drain pipe was identified within the Alkylation Unit area. The drain pipe was utilized to drain sulfuric acid in the Alkylation Unit.	Upon identifying the release, HC-PR repaired the drain pipe and excavated approximately 6 cubic yards of soil.
8/14/2008	08-08-14-0949-36	HS-20	AOC-10	Southwest corner of Loading Rack Tank Field	Approximately 30-gallons of gasoline	It is suspected that a small quantity of gasoline was resident in the stormwater sewer system after tank bottom water draining and the material backed out of the storm sewer system during a rainfall event.	During the initial assessment, one possible cause under review was a possible leak from an underground pipeline. The pipeline was confirmed to be sound and not the cause of the release. Procedures for draining tank bottom water will be reviewed to prevent a reoccurrence. Closure requested 9/11/2008
5/19/2009	09-05-19-1218-35	HS-21	HS-21	Water draw sump of Tank 7930	Unknown	A hole was discovered in the water draw sump from Tank 7930. Gasoline impacted water was identified entering the sump.	Approximately 2.5 feet of impacted soil was removed. Soil sample 7930 Sump PE-1 was collected and analyzed for VO+10. The results indicated several compounds above the NJDEP IGWSRS. On October 28, 2009, one (1) temporary monitoring well (TK-7930-TW-1) was installed. The sample was analyzed for VO+10 and BN+15. The results indicate that all results are below the NJDEP GWQS.
4/25/2010	10-04-25-0820-32	HS-22	HS-22	Wastewater outfall	Approximately 3-gallons	An upset of the wastewater treatment plant occurred. The wastewater plant was placed into the recirculation mode and corrective measures were performed to bring the plant back to normal conditions. When the discharge to the Arthur Kill	The sheen occurred within an area containing permanently deployed boom. The discharge to the wastewater treatment plant was discontinued. Additional backwashing of wastewater equipment was performed. Absorbent boom and sweep were deployed
7/17/2010	10-07-17-0836-07	HS-23	HS-23	South Dock	2-4 gallons of Algerian residual	Spray out of barge pan resulted in 2-4 gallons of Algerian resid spilling into the water. A communication problem occurred between dock and PIC, causing a hose to be disconnected prematurely. Product discharged into the barge pan causing a discharge onto dock.	Ken's Marine brought in to assist with cleanup. A sheen was noted in the water, mostly under the South Dock.

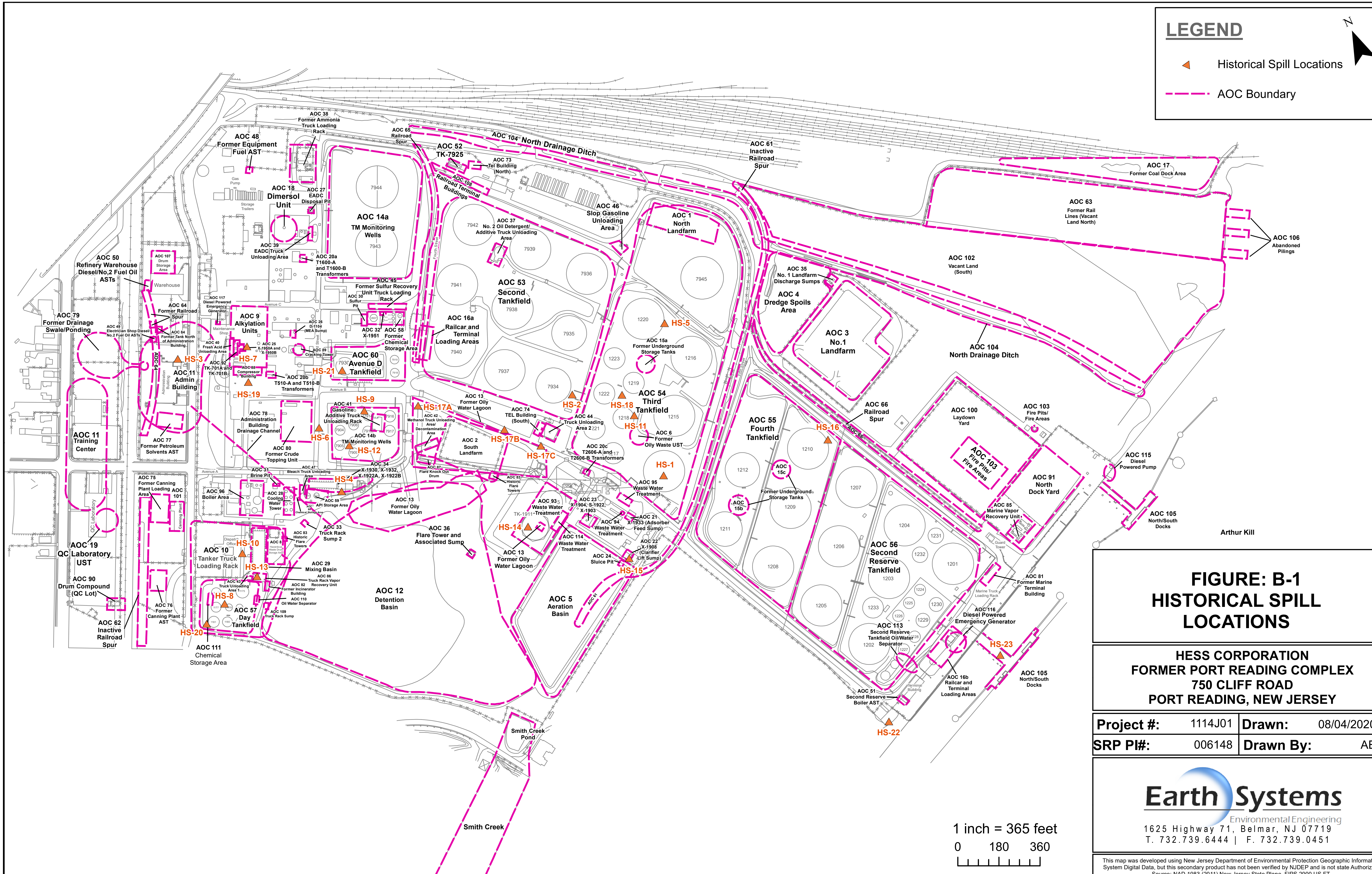

FIGURE: B-1 HISTORICAL SPILL LOCATIONS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	08/04/2020
SRP PI#:	006148	**Drawn By:**	AE

Earth Systems
Environmental Engineering
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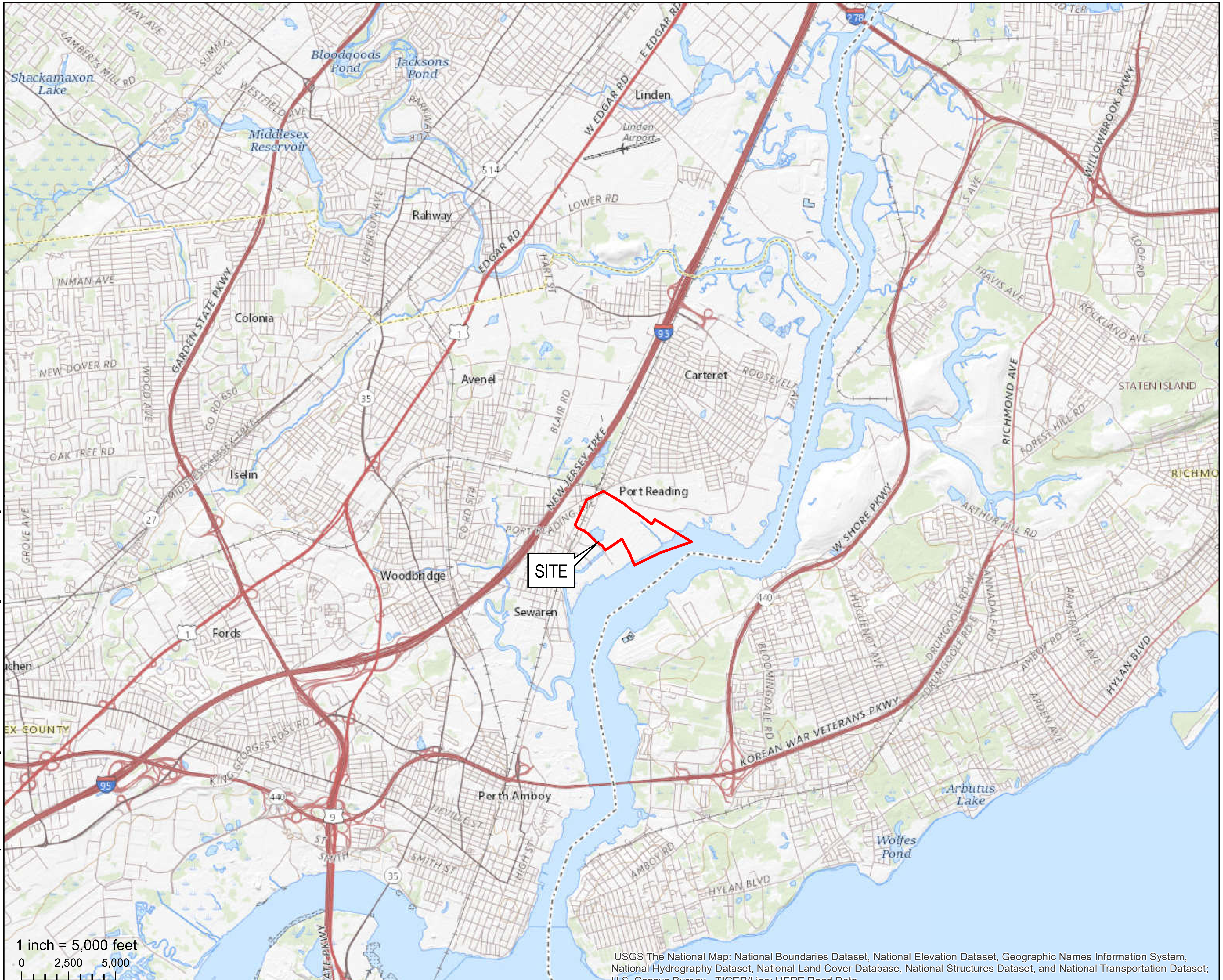
Attachment C

Figures



USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data

Document Path: P:\ArcGIS\HESS Projects\1114J00 - Port Reading Hess\1114J01 - Sitewide\GIS\Port Reading - USGS Site Location Figure.mxd

N

LEGEND

Port Reading Site Boundary

NEW JERSEY QUADRANGLE LOCATION: JERSEY CITY, NEW JERSEY

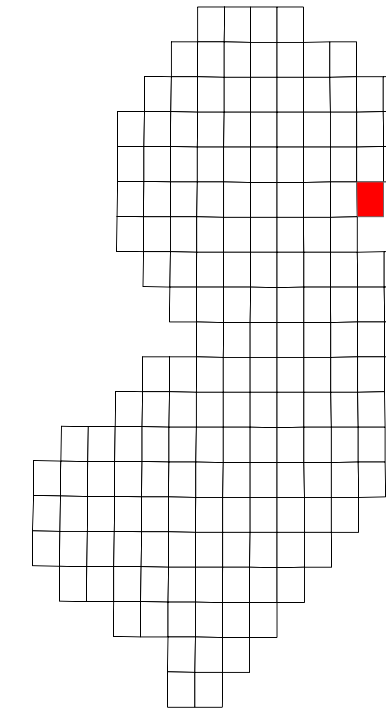


Figure 1: USGS Site Location Map

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	4/16/2020
SRP PI#:	006148	**Drawn By:**	KJ

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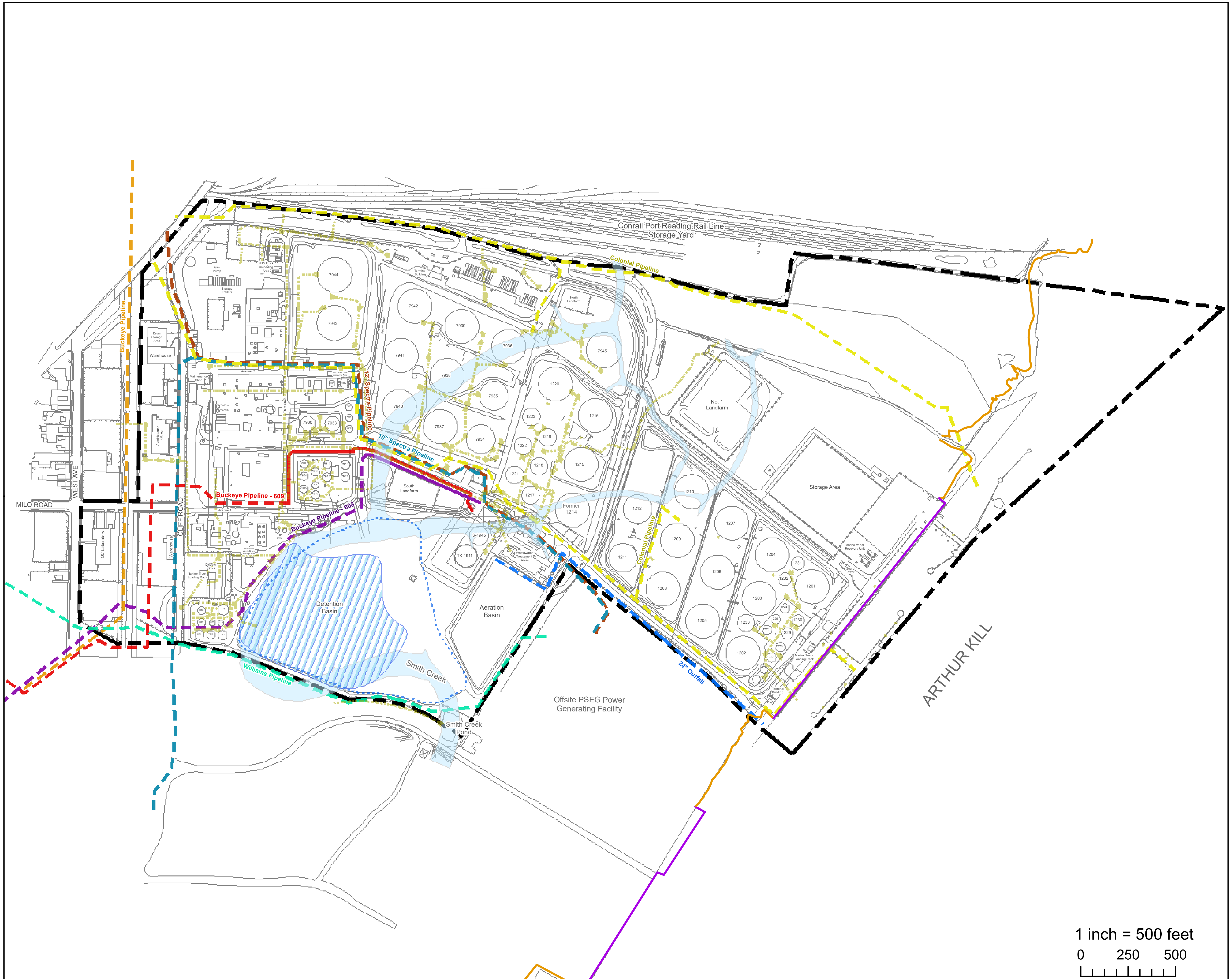
Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.



LEGEND

- Site Boundary
- AOC 12 Extent
- Basin Present Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

- 10" Spectra Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Williams Pipeline
- Sitewide Utilities/Wastewater

Utility and Pipe Line Note:
- Solid Line: Above-ground
- Dotted Line: Underground

FIGURE: 2
Site Plan

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	03/25/2021
SRP PI#:	006148	**Drawn By:**	KJ

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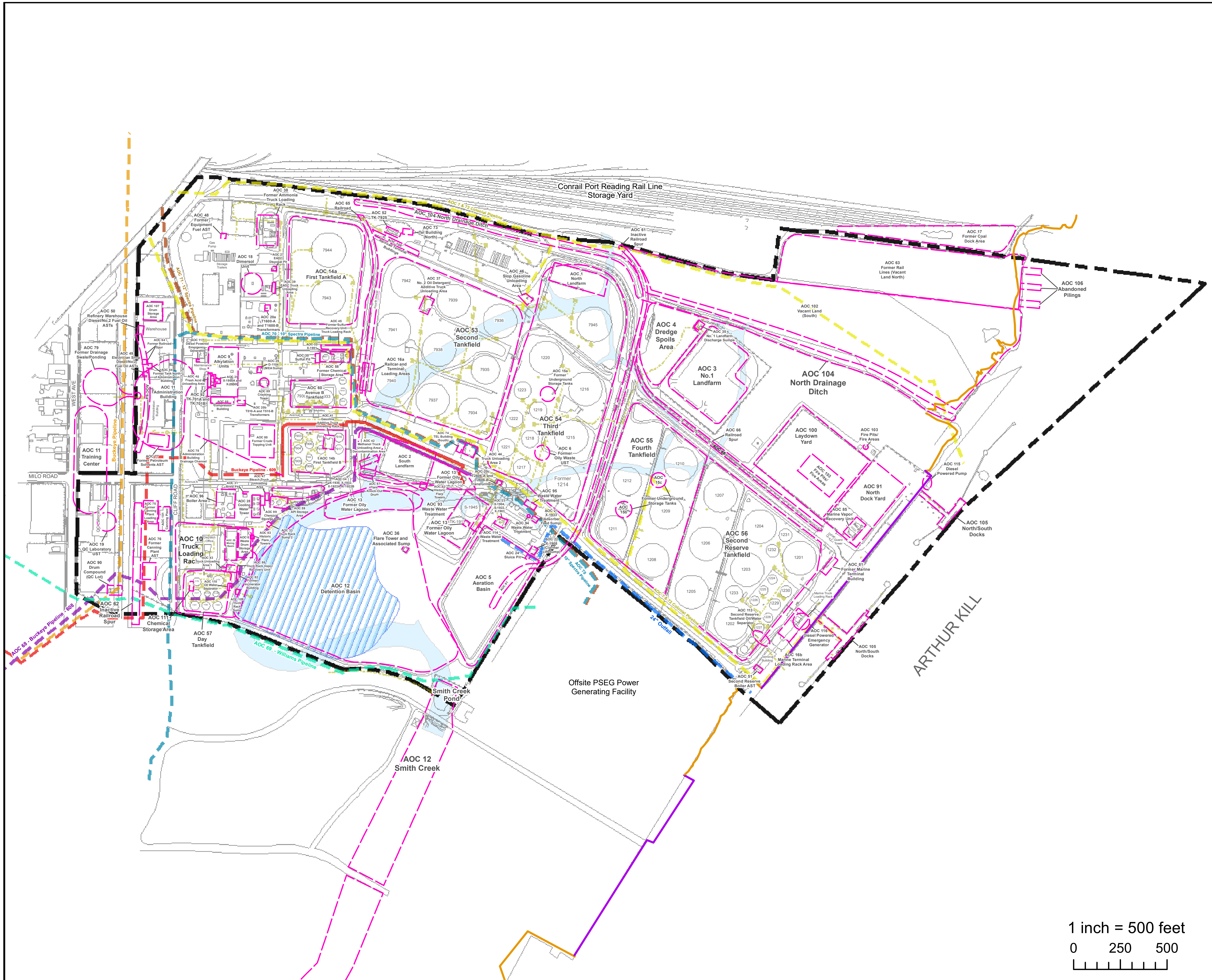

LEGEND

- AOC Boundary
- Site Boundary
- Detention Basin Current Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

- 10" Spectra Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

FIGURE: 3
AREAS OF CONCERN MAP

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/24/2021
SRP PI#:	006148	**Drawn By:**	KJ/RC

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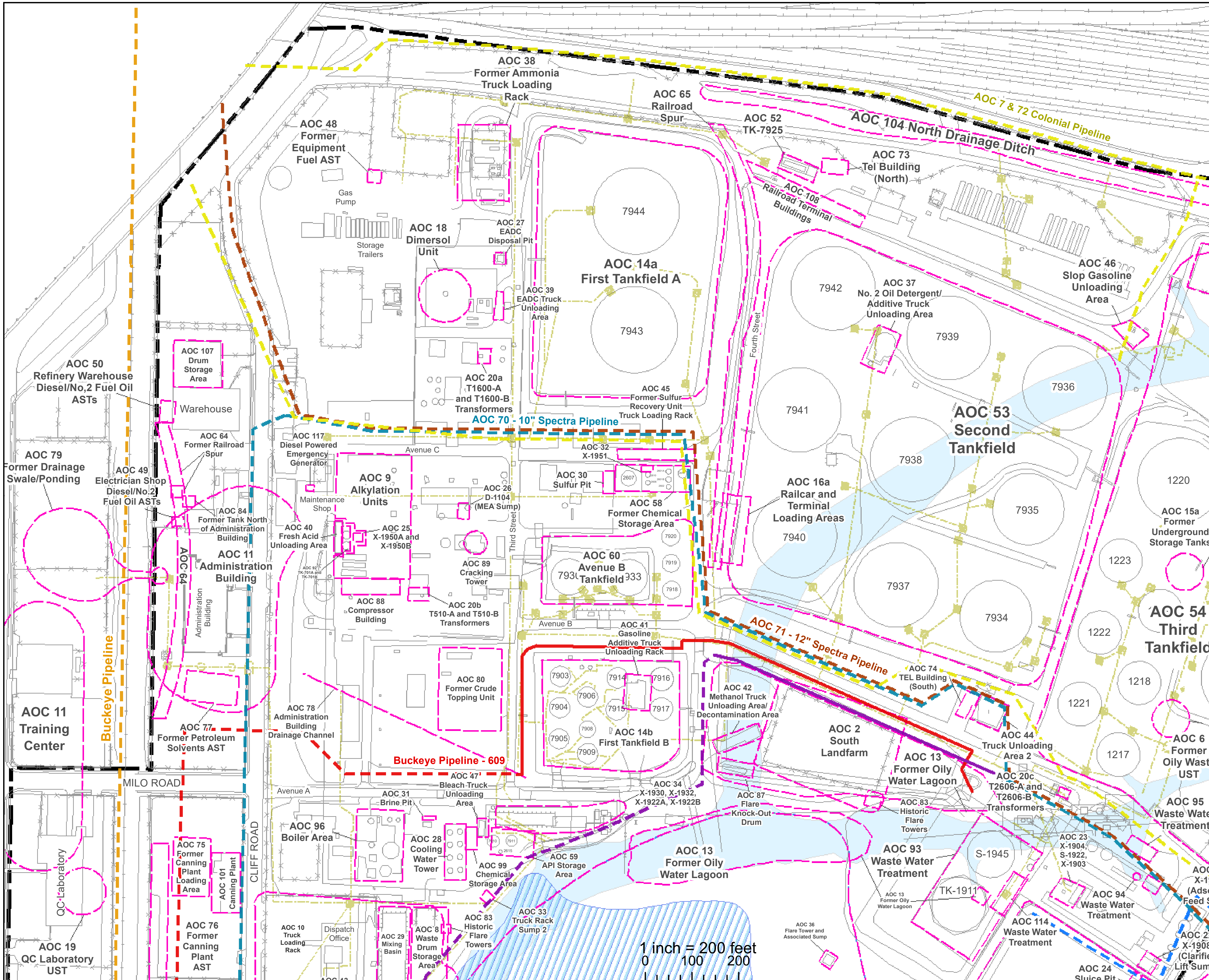

LEGEND

- AOC Boundary
- Site Boundary
- Former Smith Creek Channel
- AOC 12 Extent
- Basin Present Extents

Pipelines

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- 12" Spectra Pipeline
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- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

N

FIGURE: 3.1

AREAS OF CONCERN MAP

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/25/2021
SRP PI#:	006148	**Drawn By:**	KJ,RC

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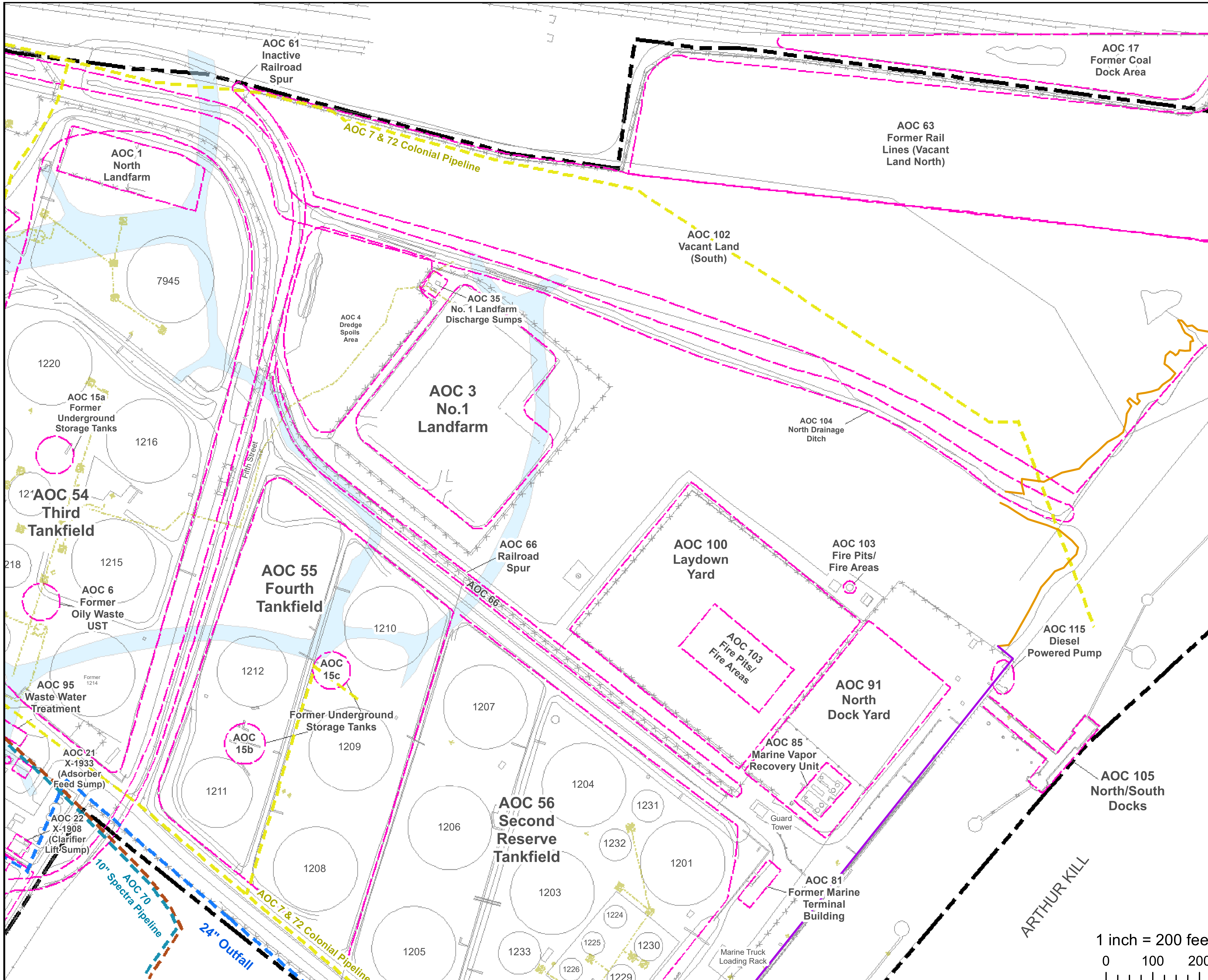

LEGEND

- AOC Boundary
- Site Boundary
- Detention Basin Current Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

- 10" Spectra Natural Gas Pipeline
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- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

FIGURE: 3.2
AREAS OF CONCERN MAP

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/26/2021
SRP PI#:	006148	**Drawn By:**	KJ,RC

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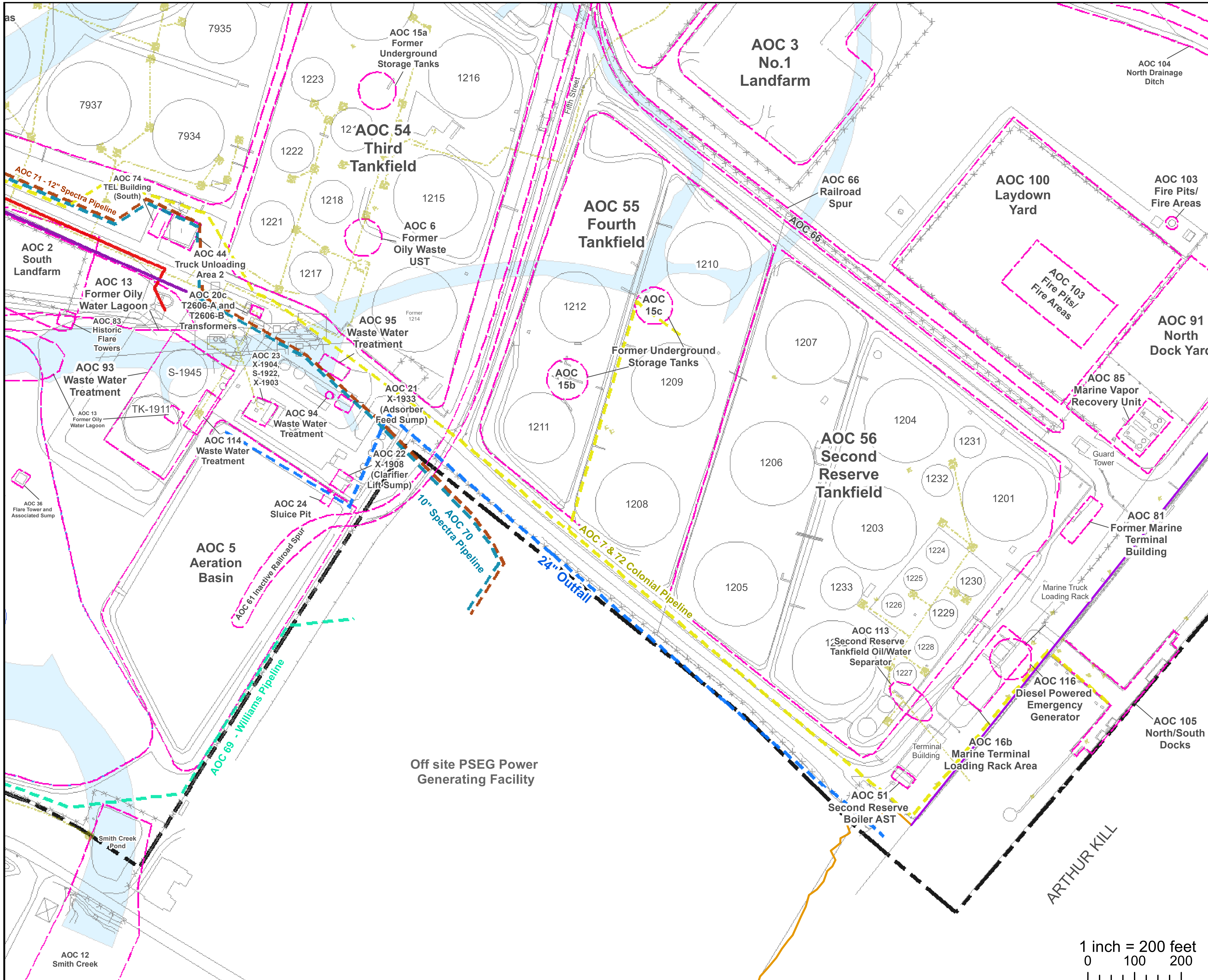

LEGEND

- AOC Boundary
- Site Boundary
- Detention Basin Current Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

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Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

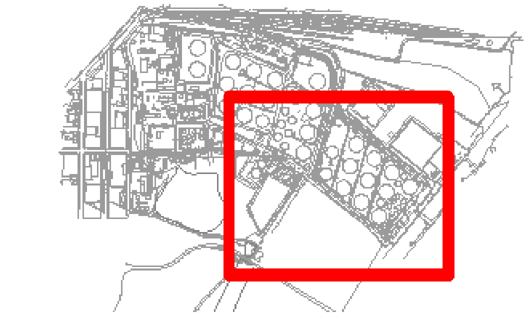

FIGURE: 3.3
AREAS OF CONCERN MAP

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/23/2021
SRP PI#:	006148	**Drawn By:**	KJ,RC

Earth Systems
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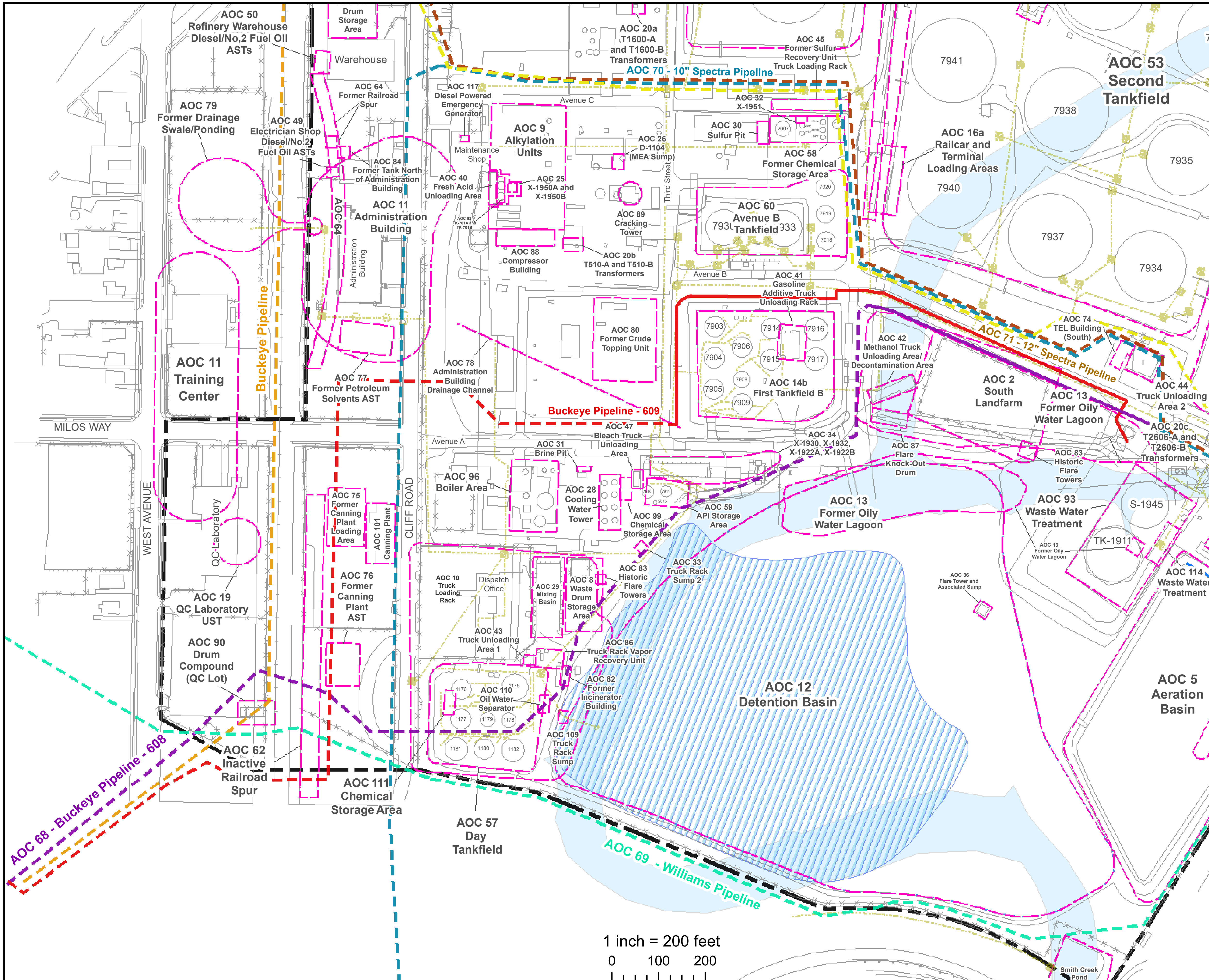

LEGEND

- AOC Boundary
- Site Boundary
- Detention Basin Current Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

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- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

FIGURE: 3.4
AREAS OF CONCERN MAP

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/23/2021
SRP PI#:	006148	**Drawn By:**	KJ,RC

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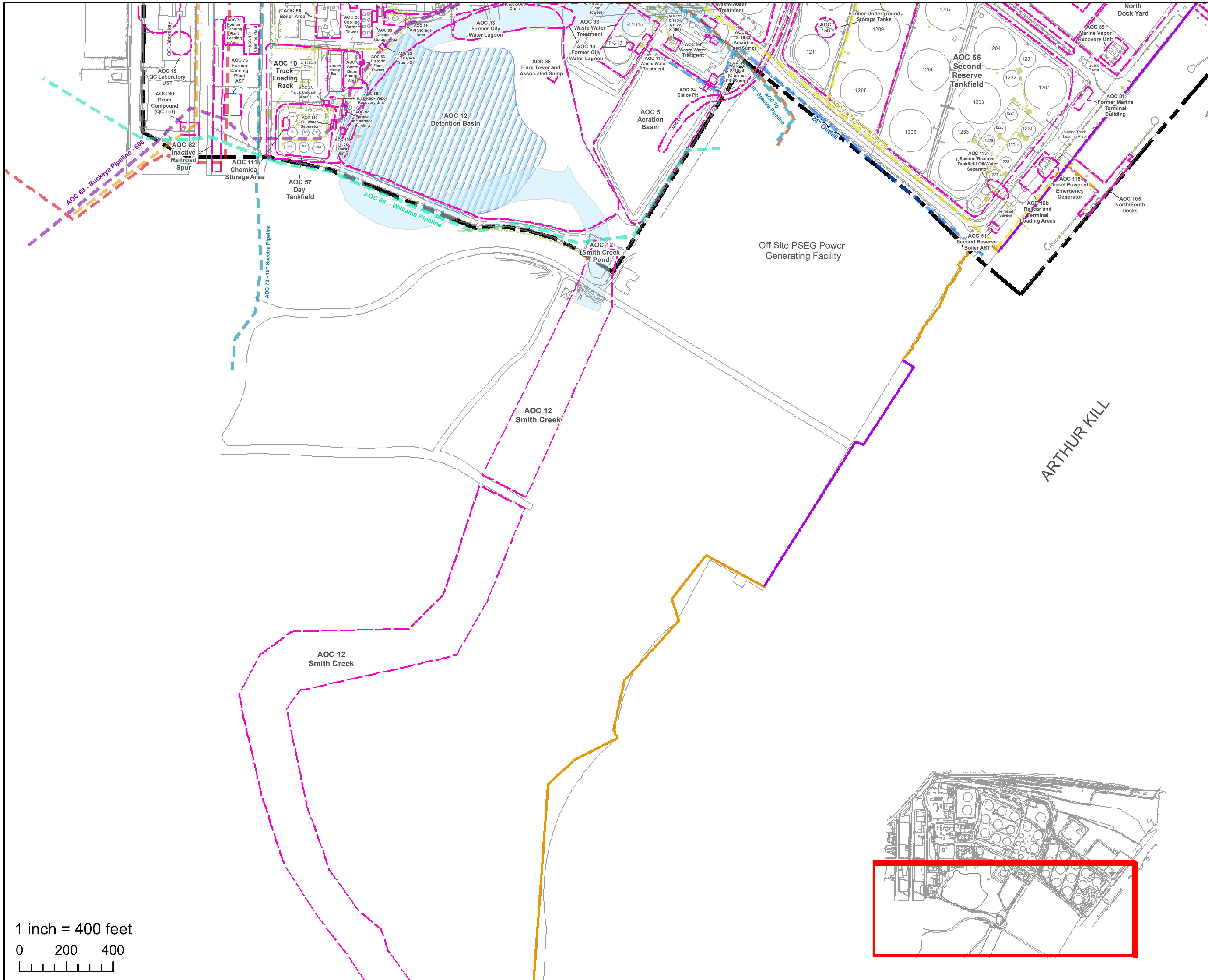

LEGEND

N

- AOC Boundary
- Site Boundary
- Detention Basin Current Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

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- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

FIGURE: 3.5

AREAS OF CONCERN MAP

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	1/26/2021
SRP PI#:	006148	**Drawn By:**	KJ,RC

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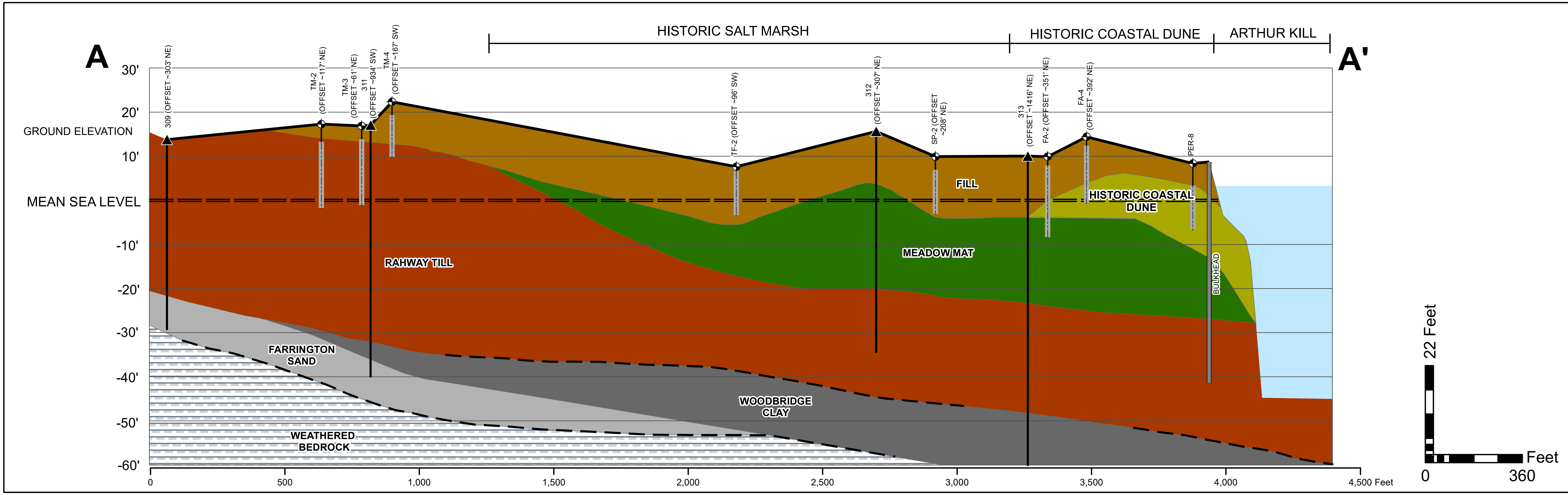

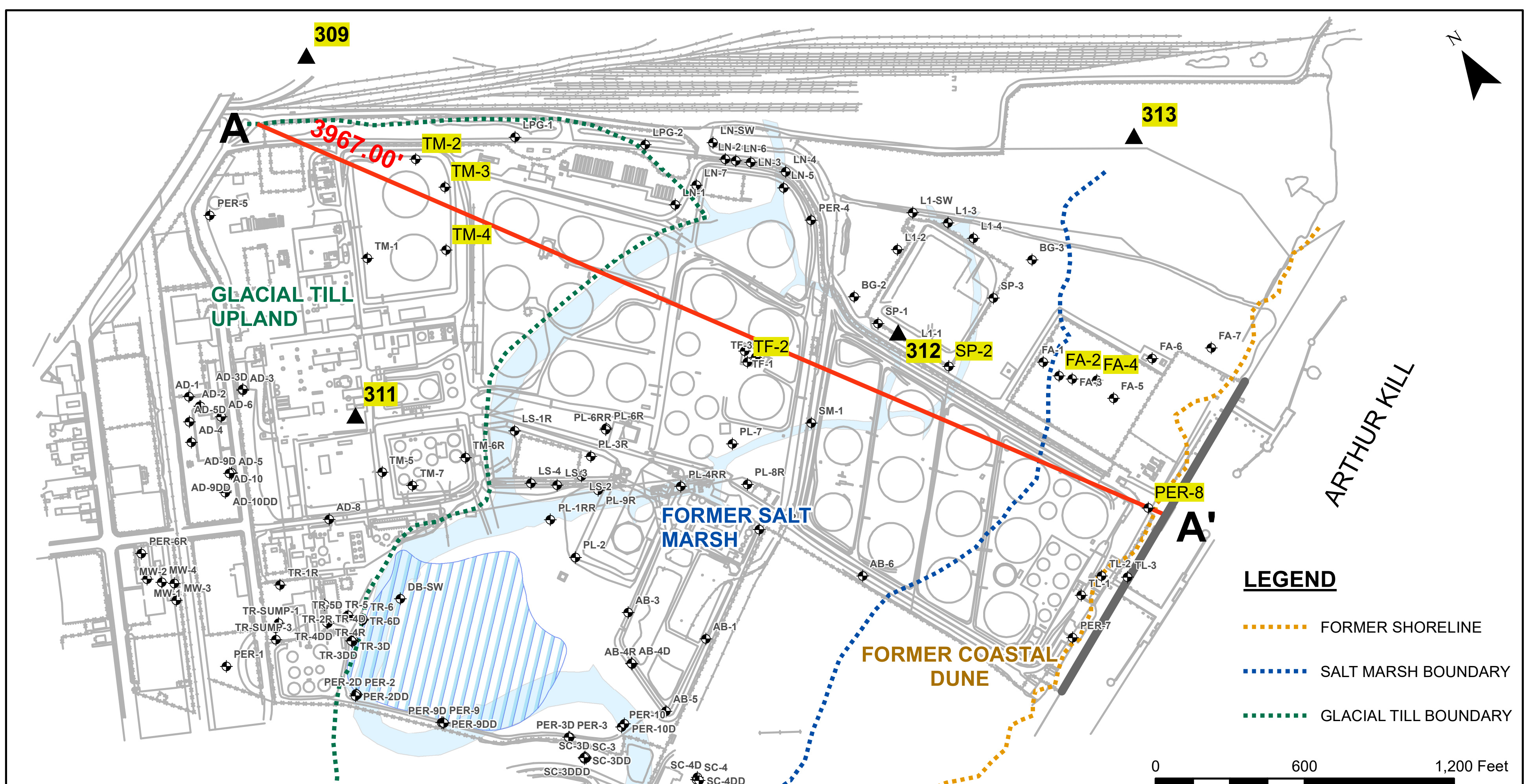

LEGEND

- STATE GEOLOGICAL INVESTIGATION BORING
- MONITORING WELL
- BULKHEAD
- GROUND ELEVATION
- MEAN SEA LEVEL
- WELL SCREEN INTERVAL
- NJGS/USGS BORING DEPTH
- MONITORING WELL CASING
- ARTHUR KILL (DEPTH ESTIMATED)

POST-GLACIAL

- HISTORIC FILL MATERIAL
- HISTORIC COASTAL DUNE
- MEADOW MAT

GLACIAL

- RAHWAY TILL

PRE-GLACIAL

- WOODBRIDGE CLAY
- FARRINGTON SANDS
- BEDROCK

NOTES:

1. Lithology data sourced from Department of Environmental Protection, Division of Science, Research and Technology New Jersey Geological Survey, Prepared in cooperation with the U.S. Geological Survey, National Geological Mapping Program, Surficial Geology of the Perth Amboy and Arthur Kill Quadrangles, Middlesex and Union Counties, New Jersey Open File Map OFM 28, along with sitewide historic soil boring logs and monitoring well construction logs.

A-A' CROSS SECTION

HESS CORPORATION
FORMER PORT READING TERMINAL
750 CLIFF ROAD, PORT READING, NEW JERSEY

Earth Systems
Environmental Engineering

DATE:	3/8/2021	PI#:	006148
	RC/SC	FIGURE: 4.1	

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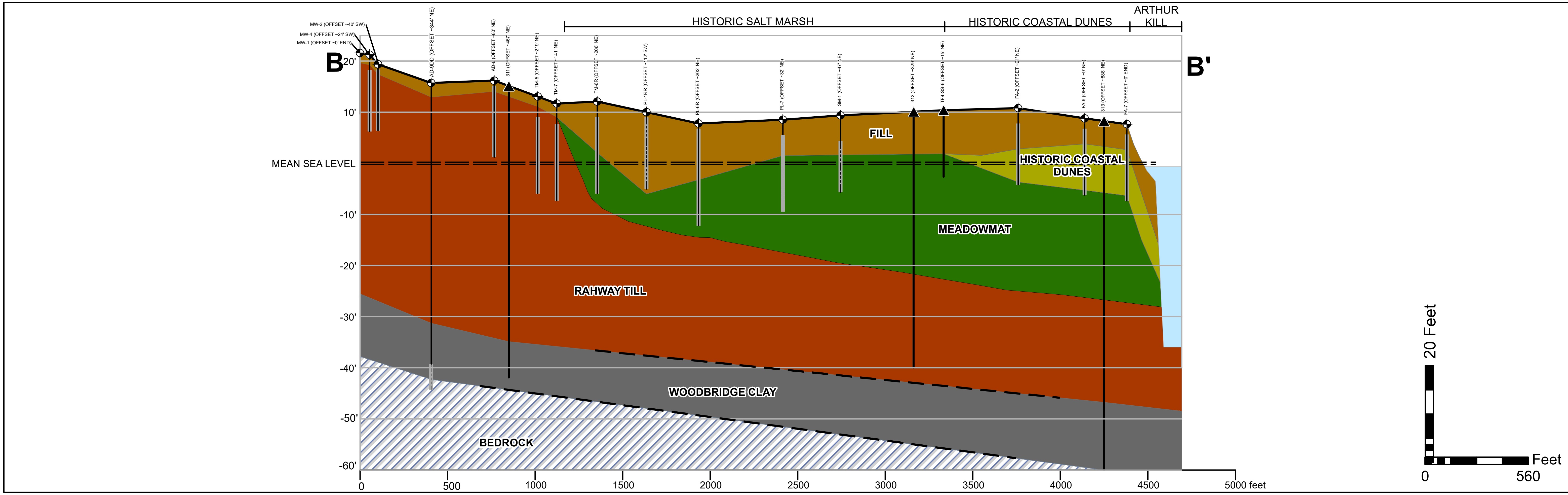

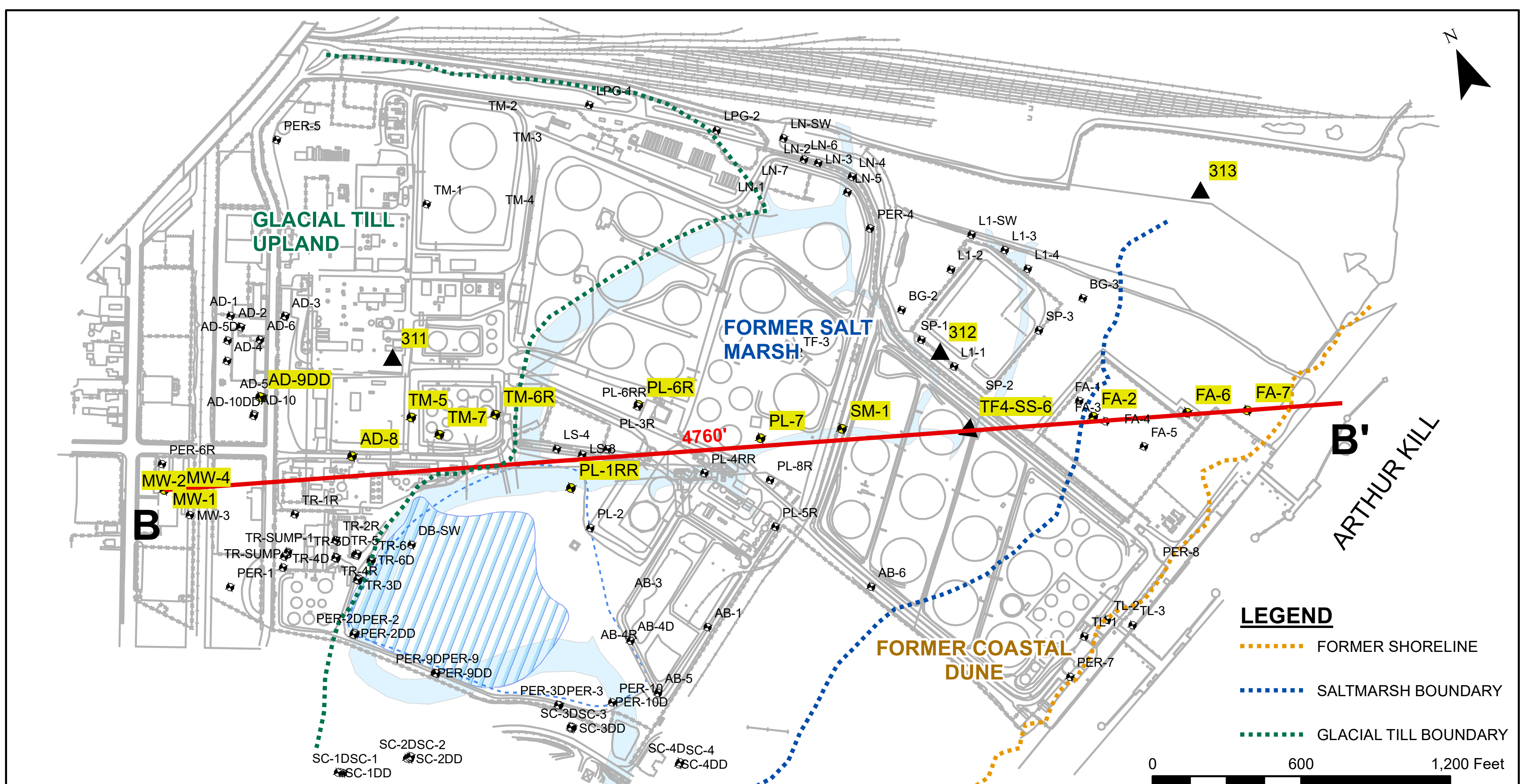

LEGEND

- ▲ STATE GEOLOGICAL INVESTIGATION BORING*
- MONITORING WELL
- BULKHEAD
- GROUND ELEVATION
- MEAN SEA LEVEL
- WELL SCREEN INTERVAL
- NJGS/USGS BORING DEPTH
- MONITORING WELL CASING
- ARTHUR KILL (DEPTH ESTIMATED)

POST-GLACIAL

- HISTORIC FILL MATERIAL
- HISTORIC COASTAL DUNE
- MEADOW MAT

GLACIAL

- RAHWAY TILL

PRE-GLACIAL

- WOODBRIDGE CLAY
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*Soil boring TF4-SS-6 is not a USGS or NJGS soil boring.

B-B' CROSS SECTION

HESS CORPORATION
FORMER PORT READING TERMINAL
750 CLIFF ROAD, PORT READING, NEW JERSEY

Earth Systems Environmental Engineering

DATE:	3/2/2021	PI#:	006148
RC/MK		FIGURE: 4.2	

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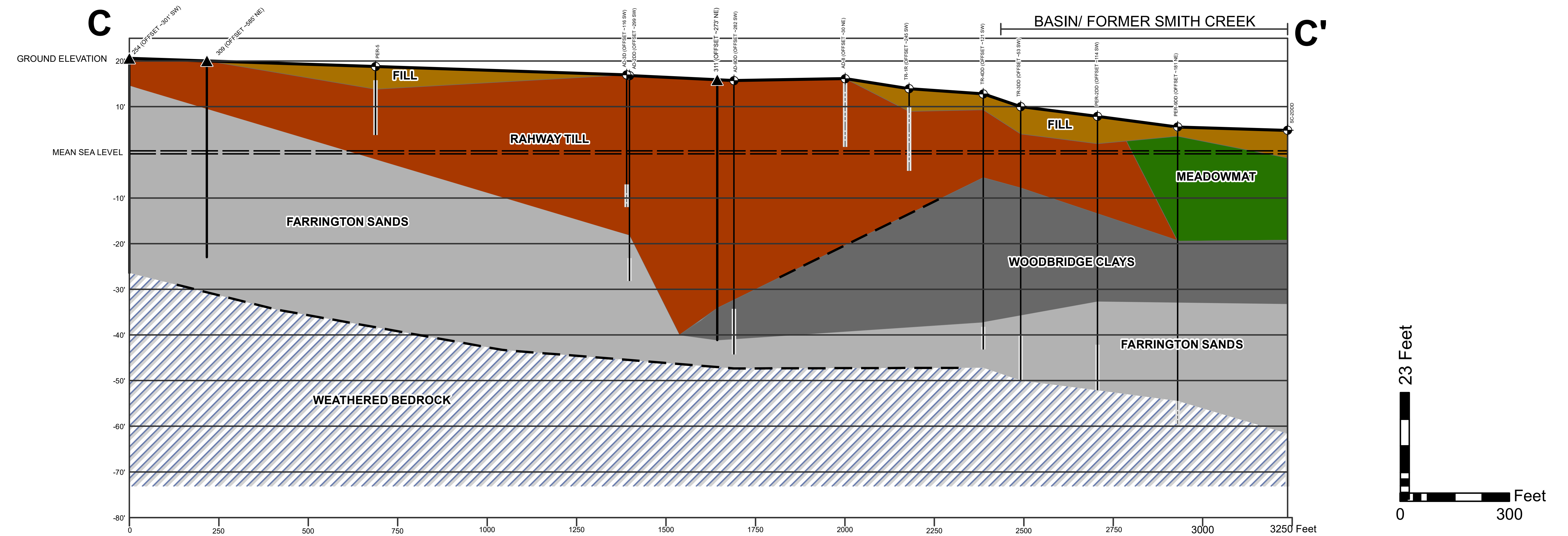

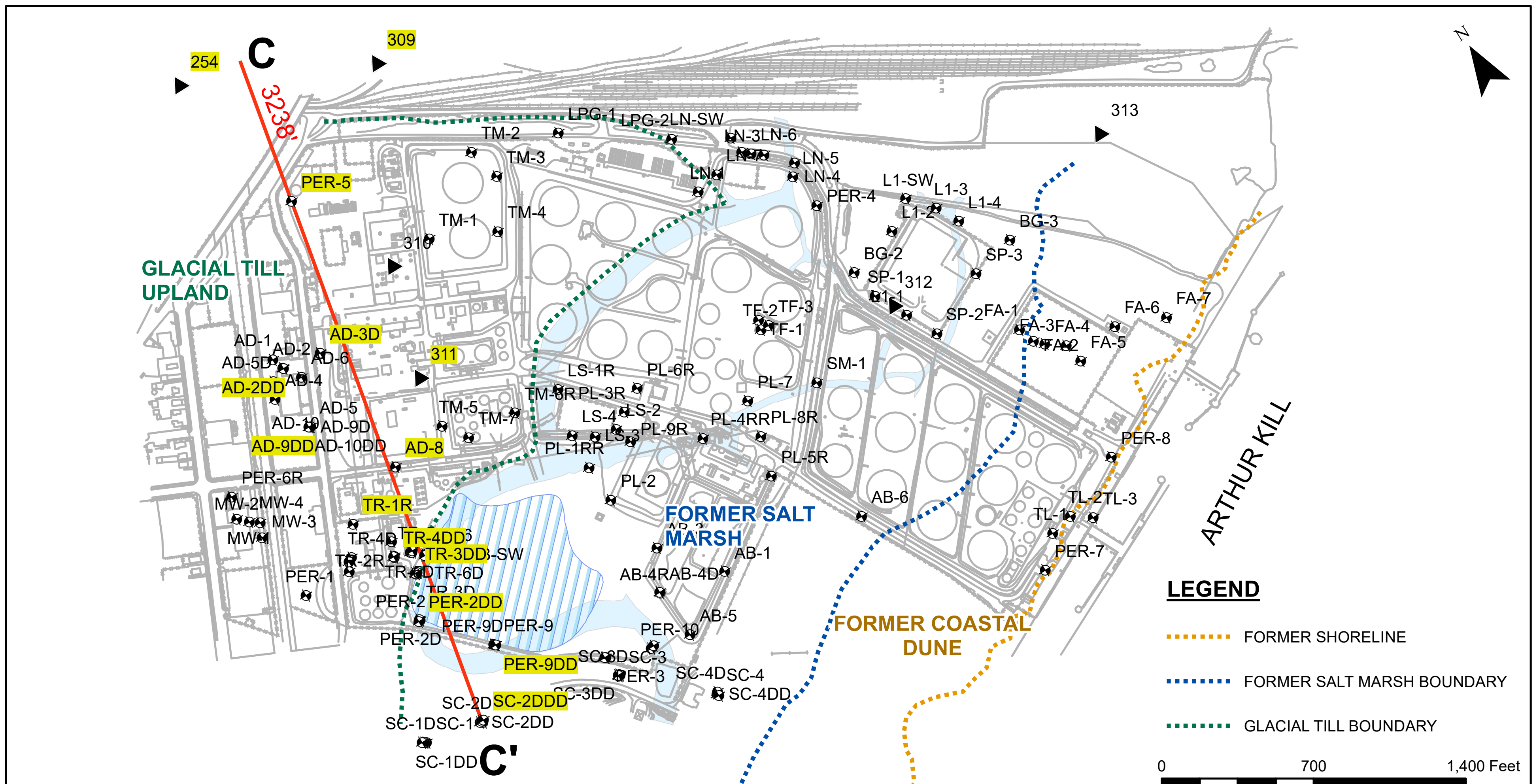

LEGEND

- STATE GEOLOGICAL INVESTIGATION BORING
- MONITORING WELL
- GROUND ELEVATION
- MEAN SEA LEVEL
- WELL SCREEN INTERVAL
- NJGS/USGS BORING DEPTH
- MONITORING WELL CASING
- ARTHUR KILL (DEPTH ESTIMATED)

POST-GLACIAL

- HISTORIC FILL MATERIAL
- MEADOW MAT

GLACIAL

- RAHWAY TILL

PRE-GLACIAL

- WOODBRIDGE CLAY
- FARRINGTON SANDS
- BEDROCK

NOTES:

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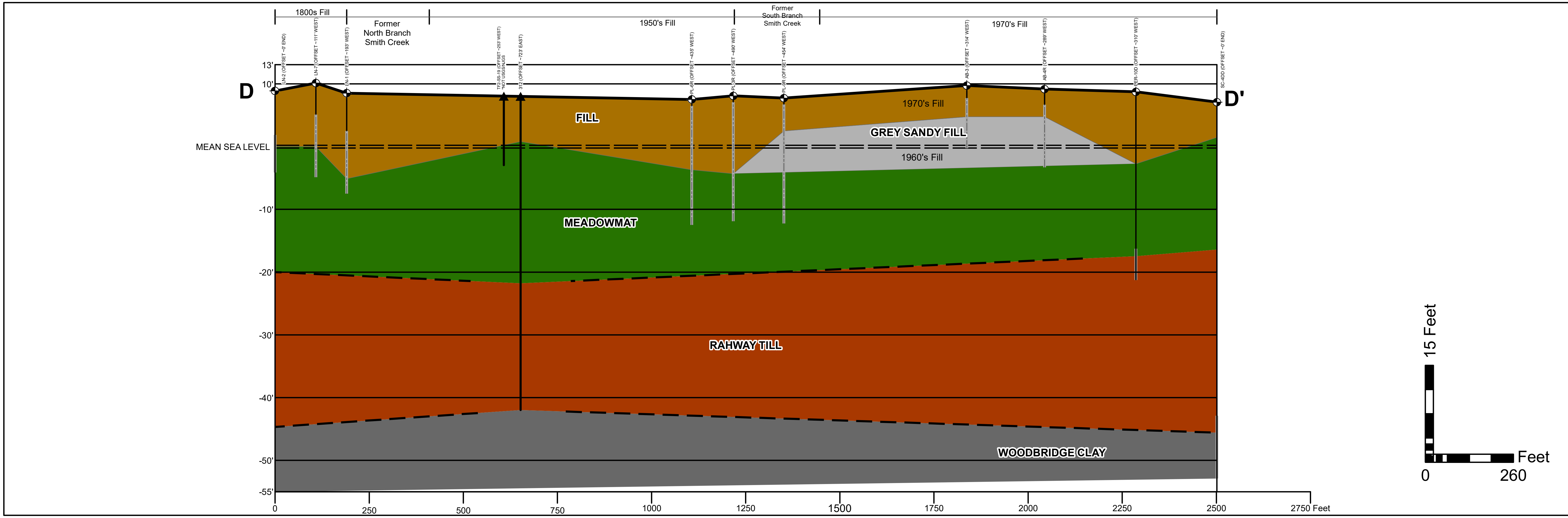
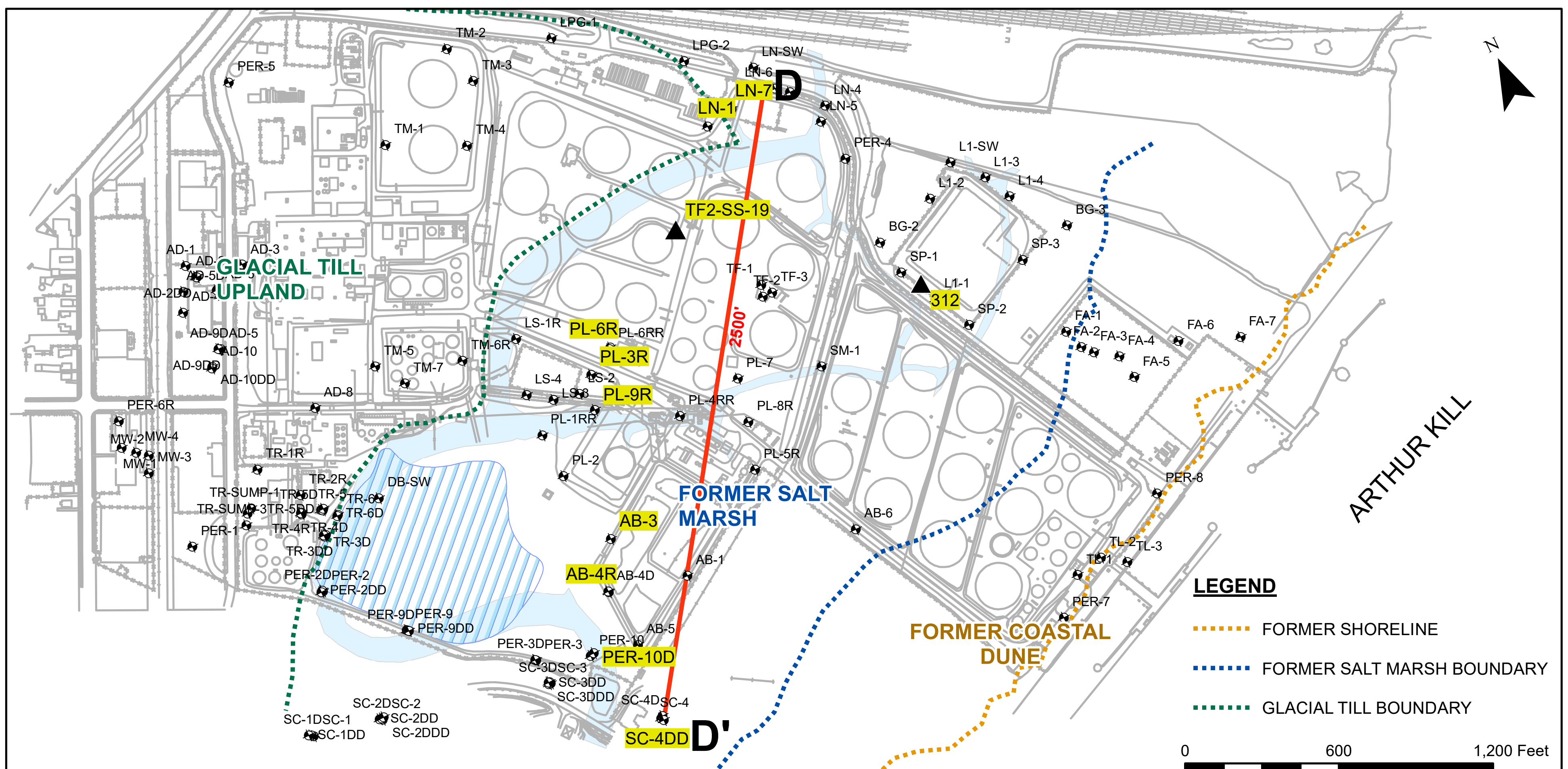
C-C' CROSS SECTION

HESS CORPORATION
FORMER PORT READING TERMINAL
750 CLIFF ROAD, PORT READING, NEW JERSEY

Earth Systems
Environmental Engineering

DATE: 3/1/2021	PI#: 006148
RC/MK	FIGURE: 4.3





LEGEND

- STATE GEOLOGICAL INVESTIGATION BORING*
- MONITORING WELL
- BULKHEAD
- GROUND ELEVATION
- MEAN SEA LEVEL
- WELL SCREEN INTERVAL
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POST-GLACIAL

- HISTORIC FILL MATERIAL
- SANDY FILL
- MEADOW MAT

GLACIAL

- RAHWAY TILL

PRE-GLACIAL

- WOODBRIDGE CLAY

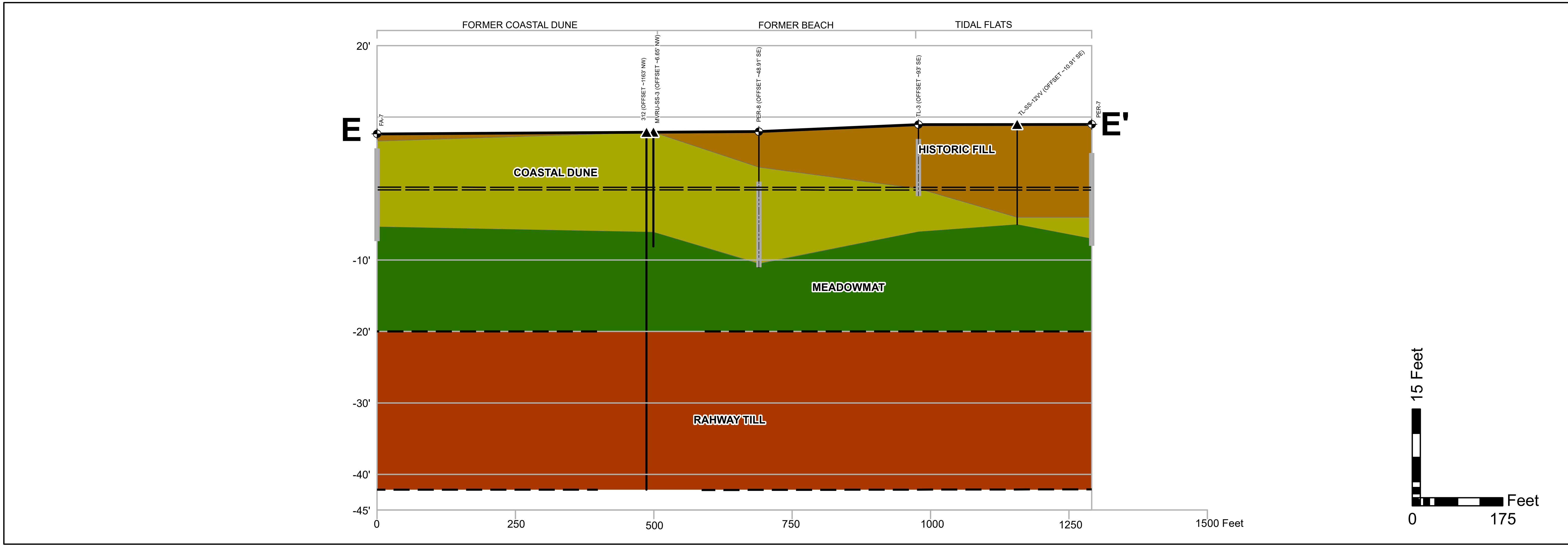
NOTES:
1. Lithology data sourced from Department of Environmental Protection, Division of Science, Research and Technology New Jersey Geological Survey, Prepared in cooperation with the U.S. Geological Survey, National Geological Mapping Program, Surficial Geology of the Perth Amboy and Arthur Kill Quadrangles, Middlesex and Union Counties, New Jersey Open File Map OFM 28, along with sitewide historic soil boring logs and monitoring well construction logs.
*Soil boring TF2-SS-19 is not a USGS or NJGS soil boring.

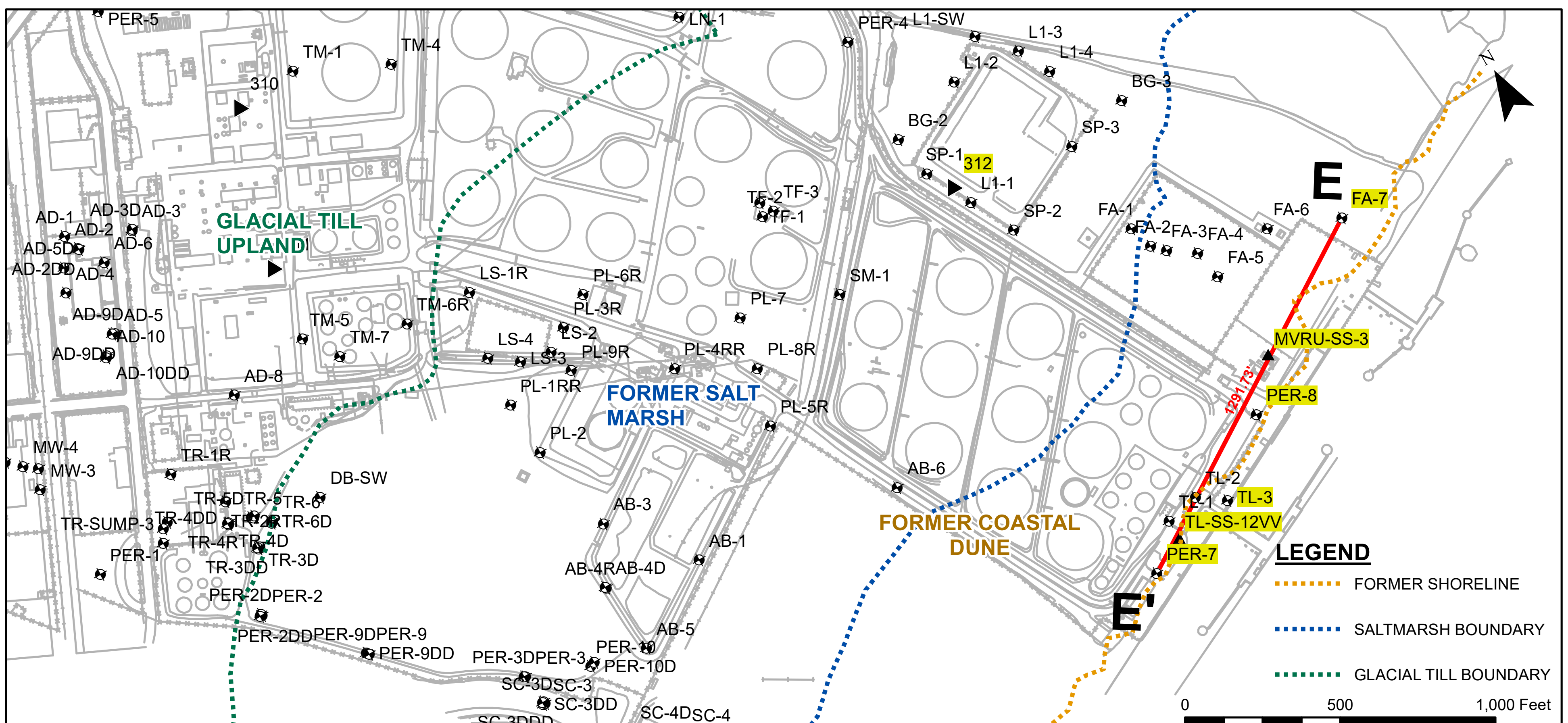
D-D' CROSS SECTION

HESS CORPORATION
FORMER PORT READING TERMINAL
750 CLIFF ROAD, PORT READING, NEW JERSEY

Earth Systems
Environmental Engineering

DATE:	3/8/2021	PI#:	006148
RC/MK		FIGURE: 4.4	





LEGEND

- STATE GEOLOGICAL INVESTIGATION BORING*
- MONITORING WELL
- GROUND ELEVATION
- MEAN SEA LEVEL
- WELL SCREEN INTERVAL
- NJGS/USGS BORING DEPTH
- MONITORING WELL CASING

POST-GLACIAL

- HISTORIC FILL MATERIAL
- HISTORIC COASTAL DUNE
- MEADOW MAT

GLACIAL

- RAHWAY TILL (POSSIBLE GLACIO-LACUSTRINE DEPOSITS)

NOTES:

1. Lithology data sourced from Department of Environmental Protection, Division of Science, Research and Technology New Jersey Geological Survey, Prepared in cooperation with the U.S. Geological Survey, National Geological Mapping Program, Surficial Geology of the Perth Amboy and Arthur Kill Quadrangles, Middlesex and Union Counties, New Jersey Open File Map OFM 28, along with sitewide historic soil boring logs and monitoring well construction logs.

*Soil boring TL-SS-12VV is not USGS or NJGS soil boring.

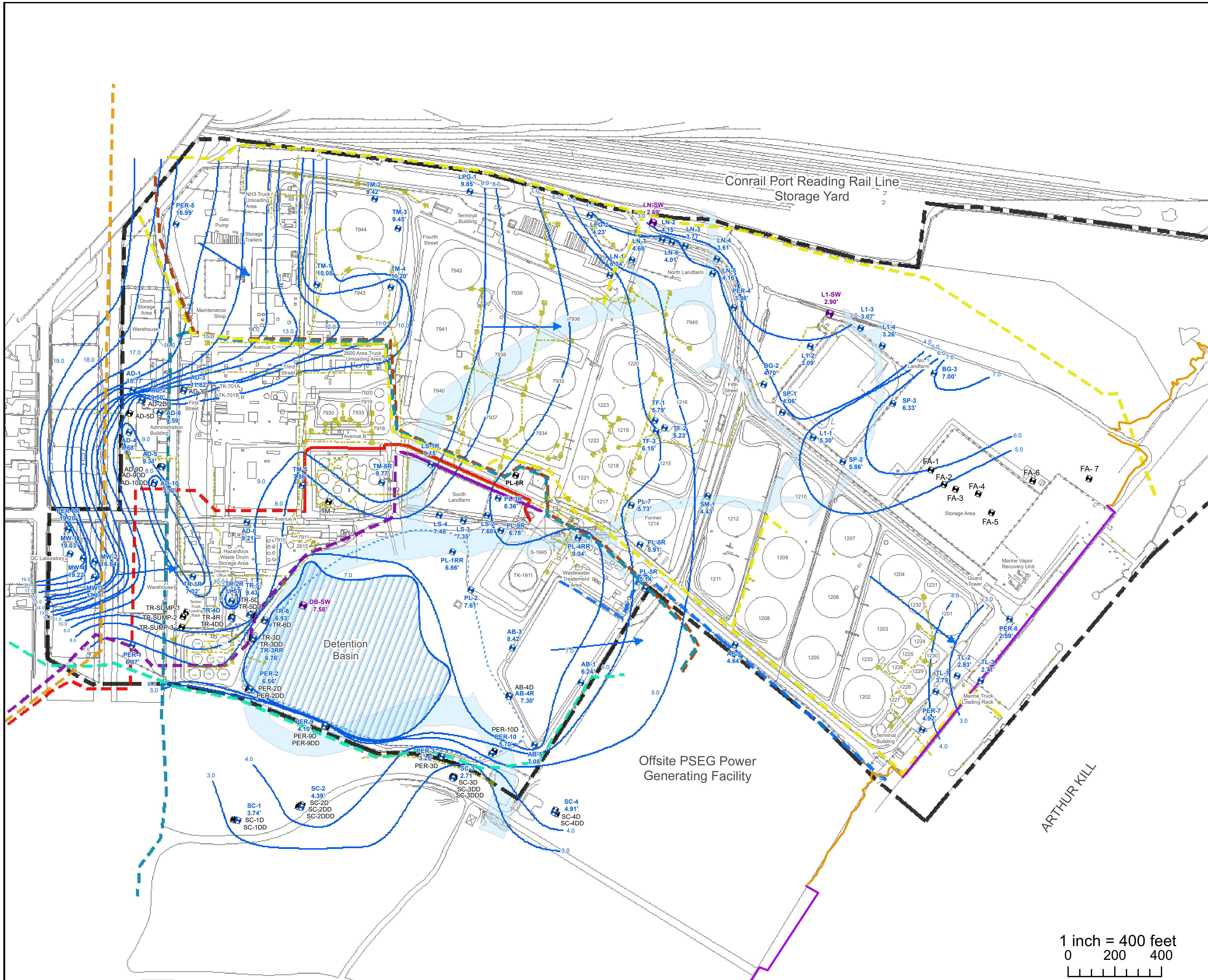
E-E' CROSS SECTION

HESS CORPORATION
FORMER PORT READING TERMINAL
750 CLIFF ROAD, PORT READING, NEW JERSEY

Earth Systems
Environmental Engineering

DATE:	3/8/2021	PI#:	006148
RC/MK		FIGURE: 4.5	

Document Path: P:\ArcGIS\HESS Projects\1114J00 - Port Reading Hess\1114J01 - Sitewide\GIS\Cross Section\Port Reading - Cross Section E-E' (previously D-D').mxd



Legend

- Surface Water Gauge
- Monitoring Well
- Shallow Monitoring Well
- Groundwater Contour Elevation
- Groundwater Flow Direction
- Site Boundary
- Former Smith Creek Channel
- Detention Basin Historic Extents
- Detention Basin Current Extents
- Shoreline
- Bulkhead

Pipelines

- 10" Spectra Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

FIGURE: 5.1
November 2019
Groundwater Contour Map
Shallow Wells

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/25/2021
SRP PI#:	006148	**Drawn By:**	KJ,AE

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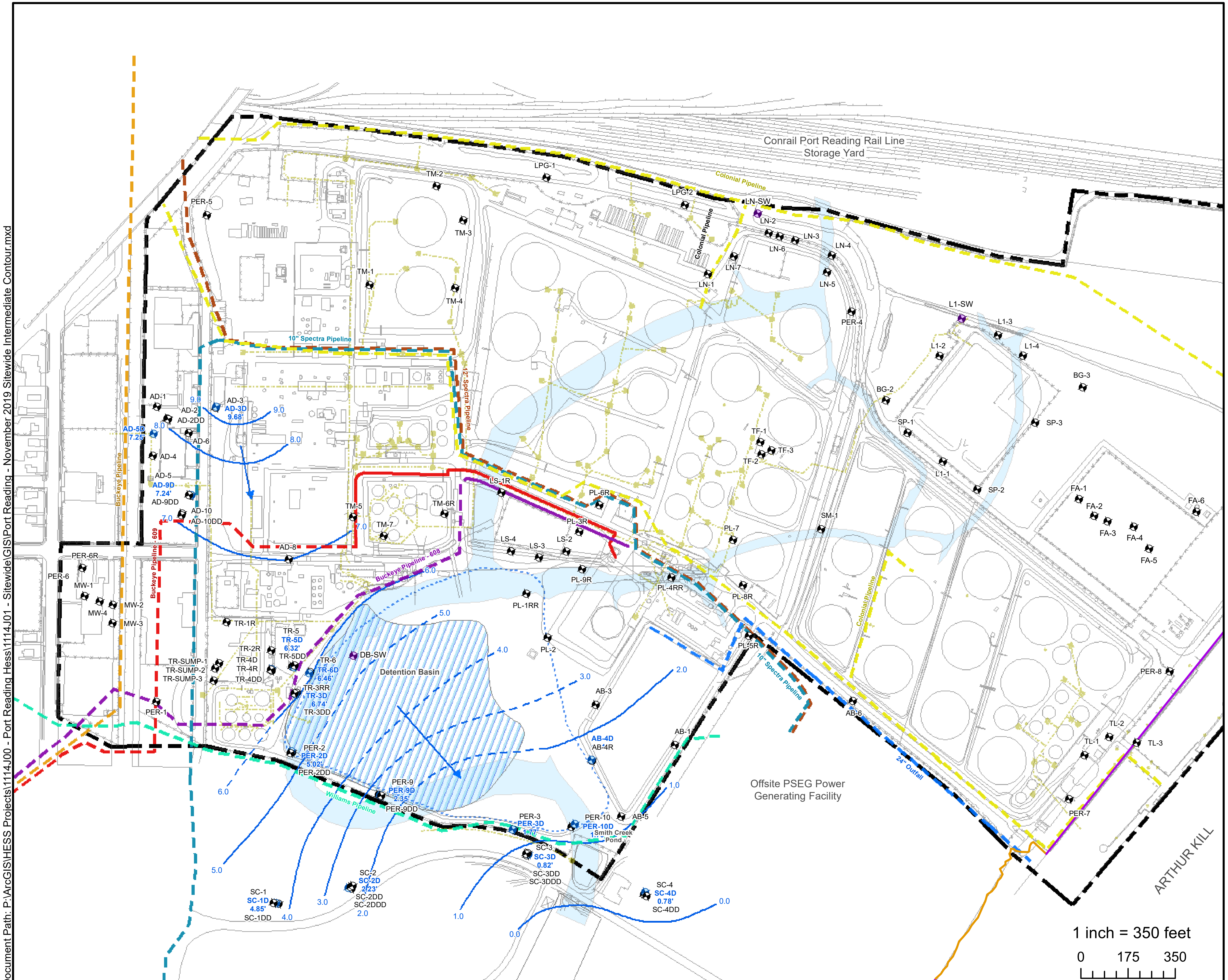

LEGEND

- Surface Water Gauge
- Monitoring Well
- Intermediate Monitoring Well
- Groundwater Elevation Contour
- Estimated Groundwater Contour
- Groundwater Flow Direction
- Site Boundary
- AOC 12 Extent
- Basin Present Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

- 10" Spectra Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

FIGURE: 5.2
November 2019
Groundwater Contour Map
Intermediate Wells

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/24/2021
SRP PI#:	006148	**Drawn By:**	KJ,AE

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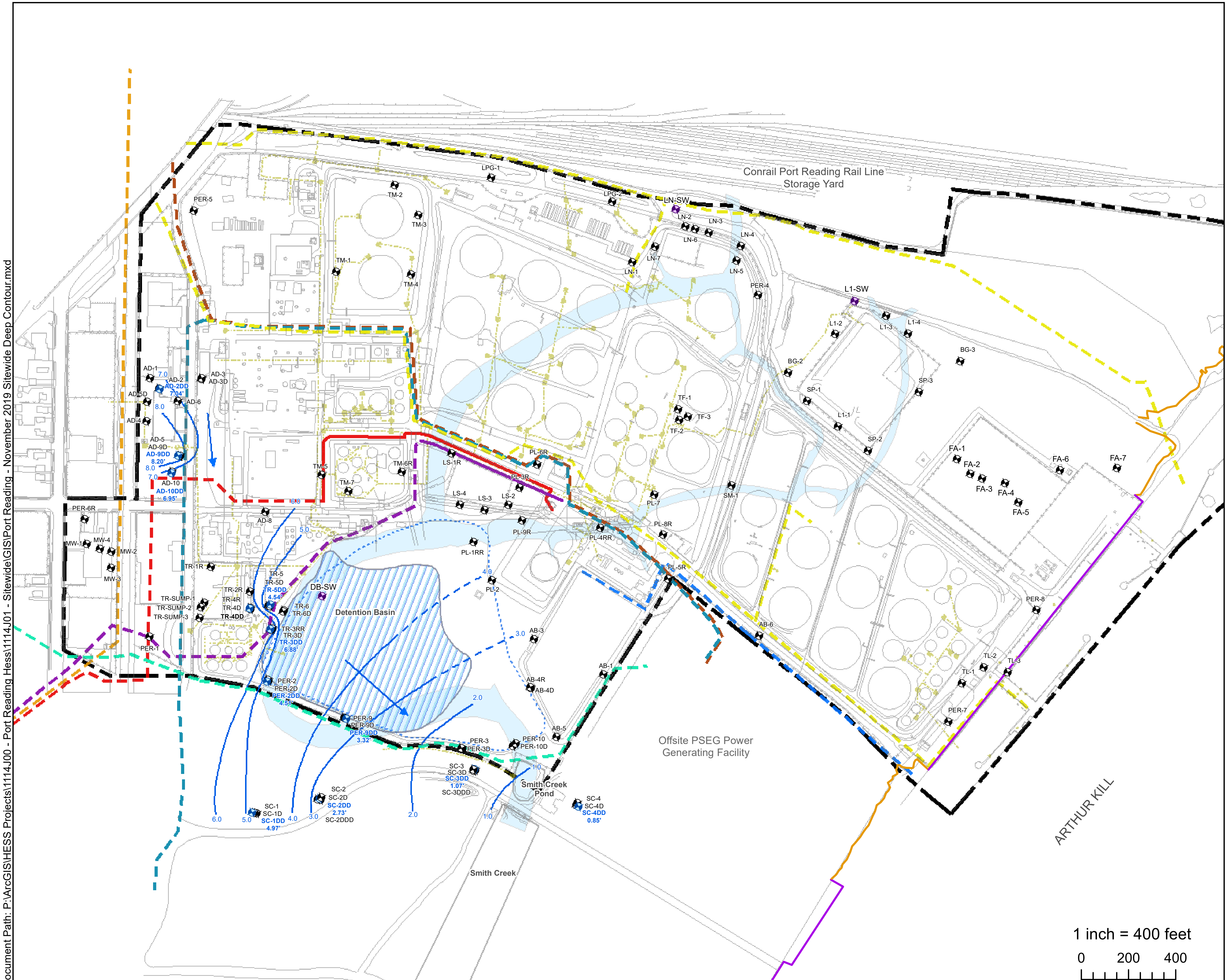

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LEGEND

- Surface Water Gauge
- Monitoring Well
- Deep Monitoring Well
- Groundwater Elevation Contour
- Estimated Groundwater Contour
- Groundwater Flow Direction
- Site Boundary
- AOC 12 Extent
- Basin Present Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Pipelines

- 10" Spectra Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Sitewide Utilities

Pipelines:
- Soild Line: Aboveground
- Dotted Line: Underground

FIGURE: 5.3
November 2019
Groundwater Contour Map
Deep Wells

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/24/2021
SRP PI#:	006148	**Drawn By:**	KJ,AE

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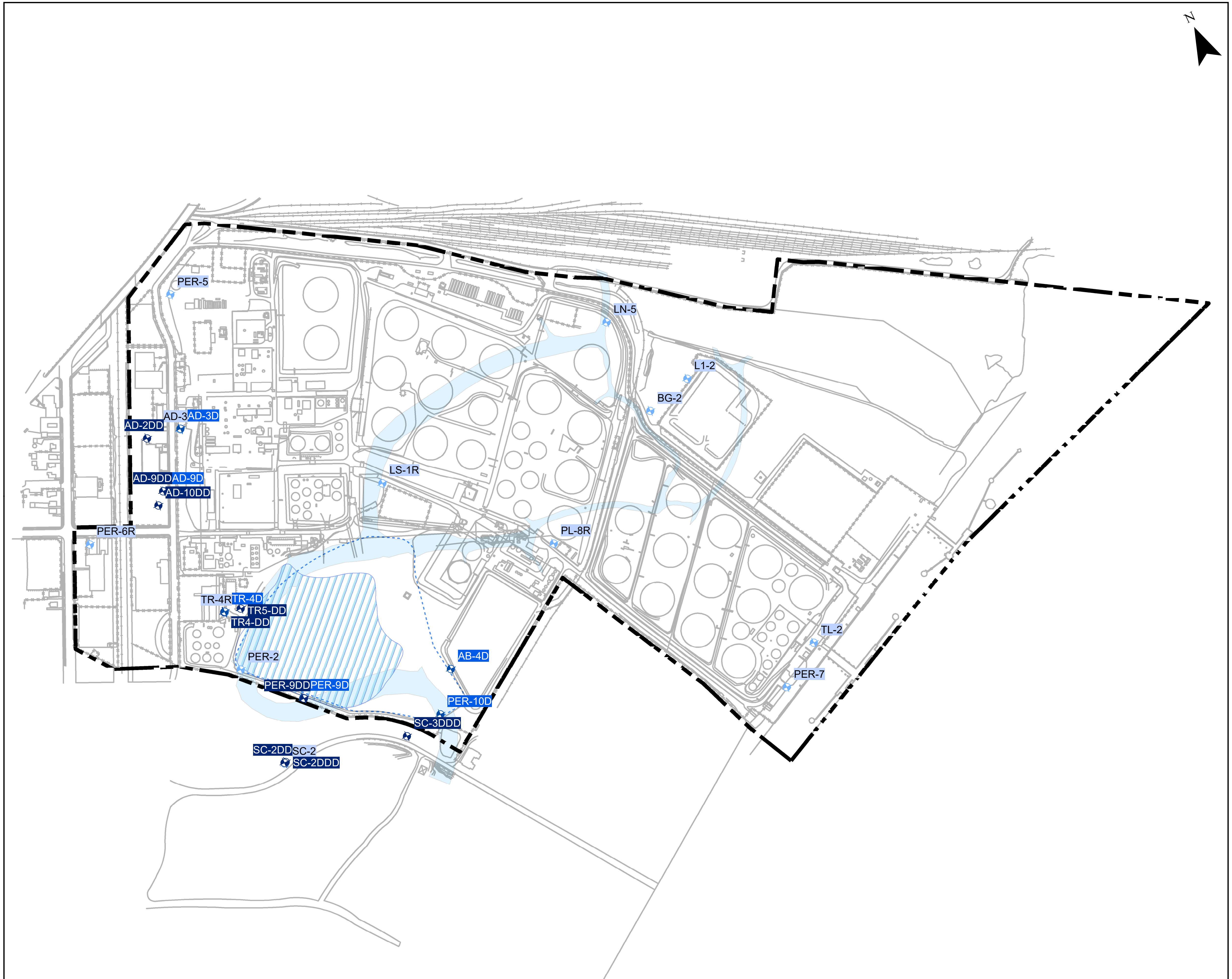

LEGEND

SCREEN INTERVAL (MIDDLE OF SCREEN)

- PER-5 SHALLOW MONITORING WELL
- AD-9D INTERMEDIATE MONITORING WELL
- AD-10DD DEEP MONITORING WELL
- DETENTION BASIN HISTORIC EXTENTS
- DETENTION BASIN CURRENT EXTENTS
- FORMER SMITH CREEK CHANNEL

1 inch = 500 feet

0 250 500 1,000 1,500 Feet

FIGURE: 5.4

Slug Test
Monitoring Wells
Water-Bearing Units

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Date:**	03/10/2021
SRP PI#:	006148	**Drawn By:**	RC

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Environmental Engineering
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Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.

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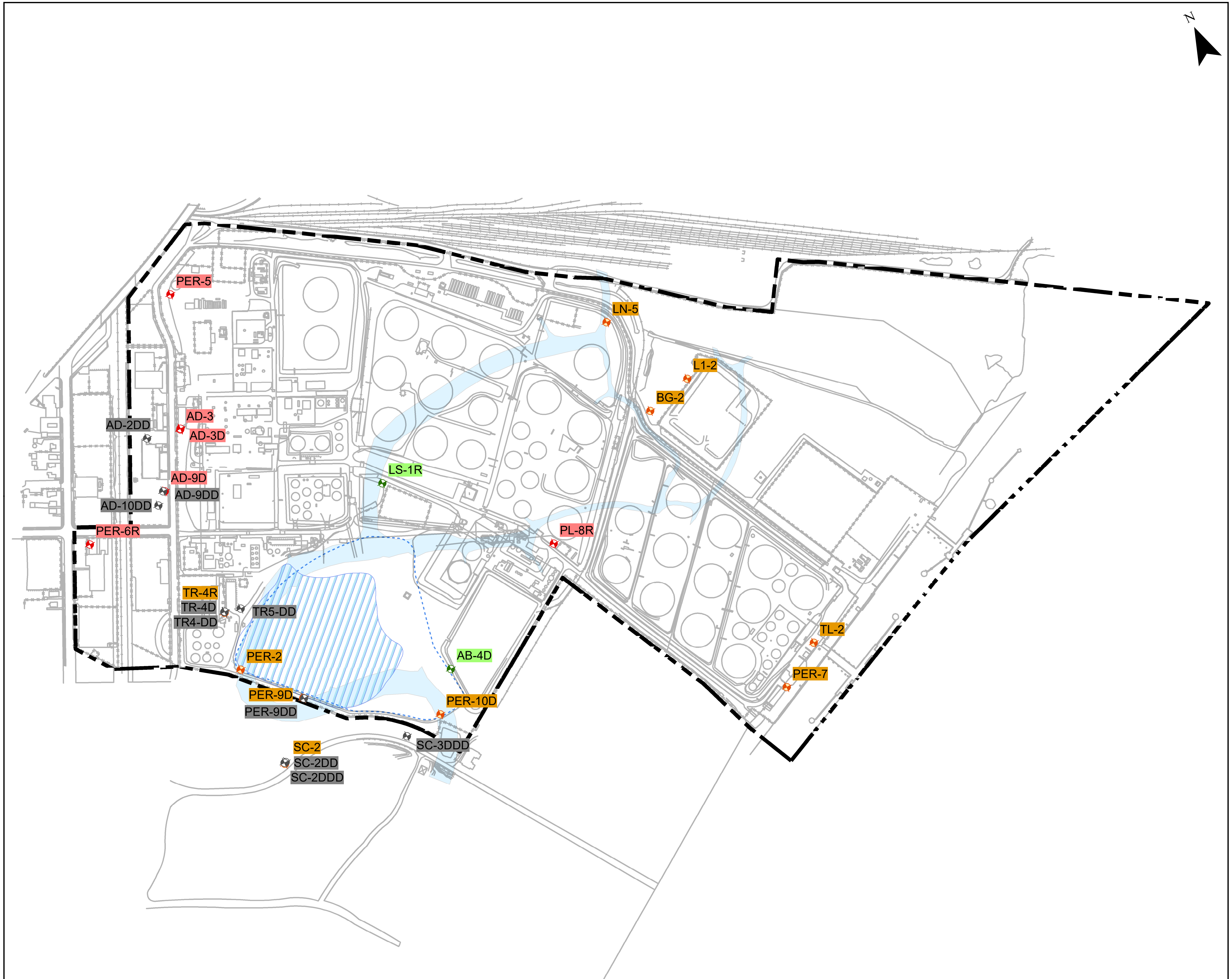

LEGEND

LITHOGRAPHIC ZONE OF SCREEN

- PER-7 FILL-MEADOWMAT
- LS-1R MEADOWMAT-TILL
- AD-9D RAHWAY TILL
- SC-2DDD RARITAN FORMATION

DETENTION BASIN HISTORIC EXTENTS

DETENTION BASIN CURRENT EXTENTS

FORMER SMITH CREEK CHANNEL

1 inch = 500 feet

0 250 500 1,000 1,500 Feet

FIGURE: 5.5
Slug Test
Monitoring Wells
Lithographic Zones

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Date:**	03/10/2021
SRP PI#:	006148	**Drawn By:**	RC

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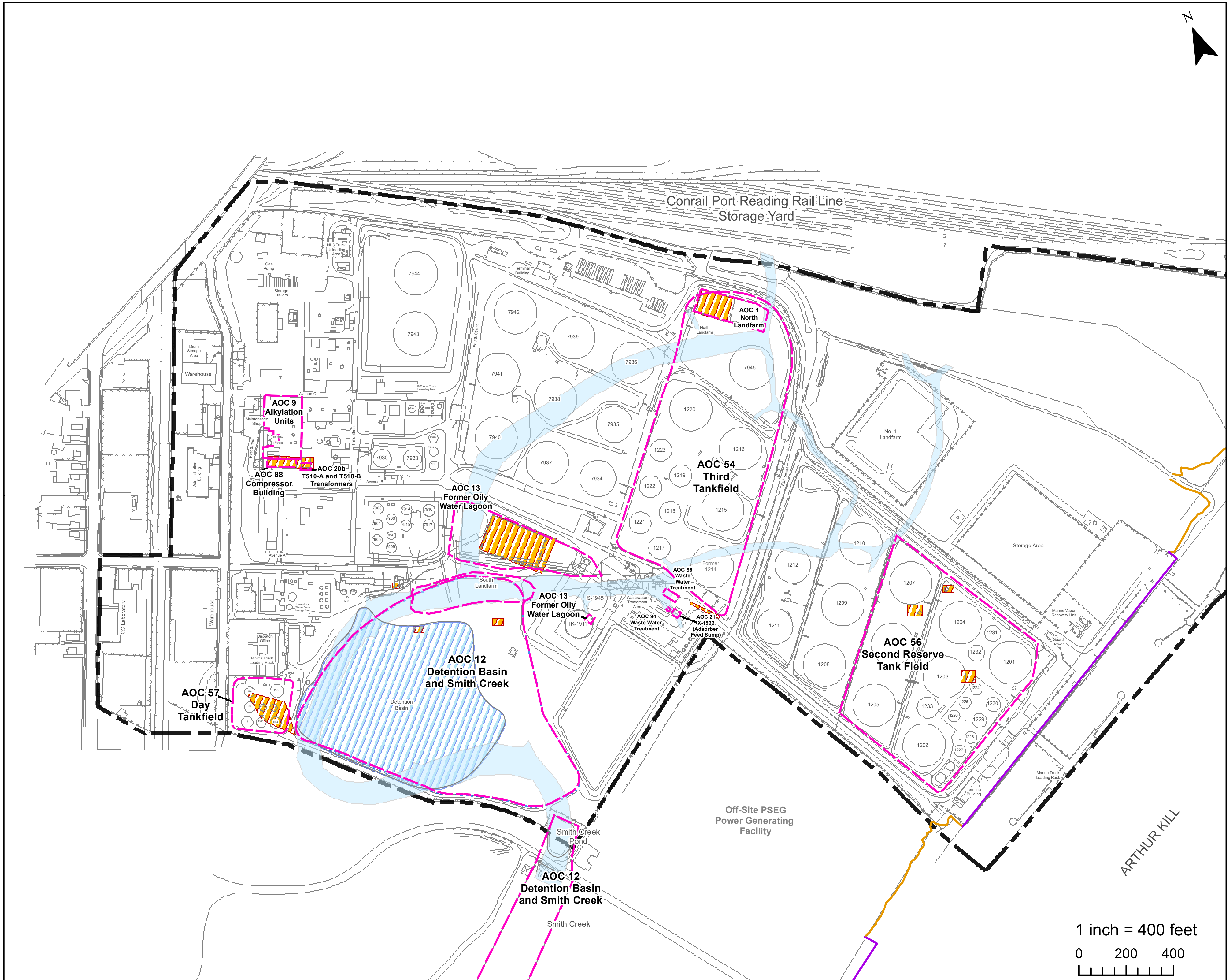

LEGEND

- Approximate Hot Spot Boundary For EPH in Soil
- Area of Concern Boundary
- Site Boundary
- Former Smith Creek Channel
- AOC 12 Extent
- Detention Basin Present Extents
- Shoreline
- Bulkhead

NOTE:
Exceedance Areas = Site Locations with soils exceeding Residential Direct Contact Soil Remediation Standard [RDCSRS] or Non-Residential Direct Contact Soil Remediation Standard [NRDCSRS], and Impact for Groundwater Standard [IGWS]
EPH= Extractable Petroleum Hydrocarbon Compounds

FIGURE: 6.1
Sitewide Soil Map
EPH Areas of Exceedance

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Date:**	03/25/2021
SRP PI#:	006148	**Drawn By:**	KJ

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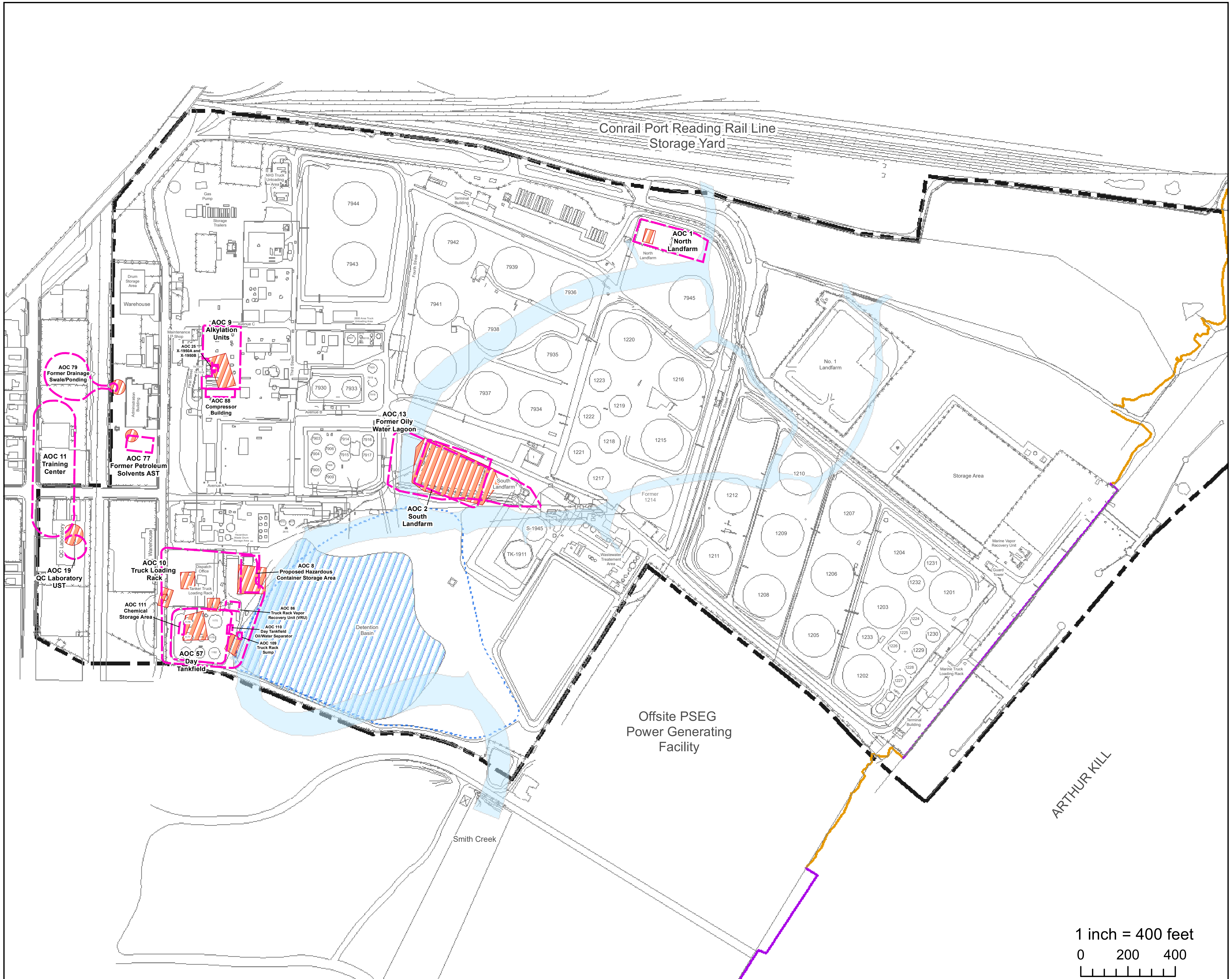

LEGEND

- Approximate Hot Spot Boundary For VOCs in Soil
- Area of Concern Boundary
- Site Boundary
- Former Smith Creek Channel
- AOC 12 Extent
- Detention Basin Present Extents
- Shoreline
- Bulkhead

NOTE:
Hot Spot = Site location with soils exceeding Residential Direct Contact Soil Remediation Standard [RDCSRS], Non-Residential Direct Contact Soil Remediation, Standard [NRDCSRS]
VOC = Volatile Organic Compound

FIGURE: 6.2

Sitewide Hot Spot Soil Exceedance Map (VOCs)

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/24/2021
SRP PI#:	006148	**Drawn By:**	AE

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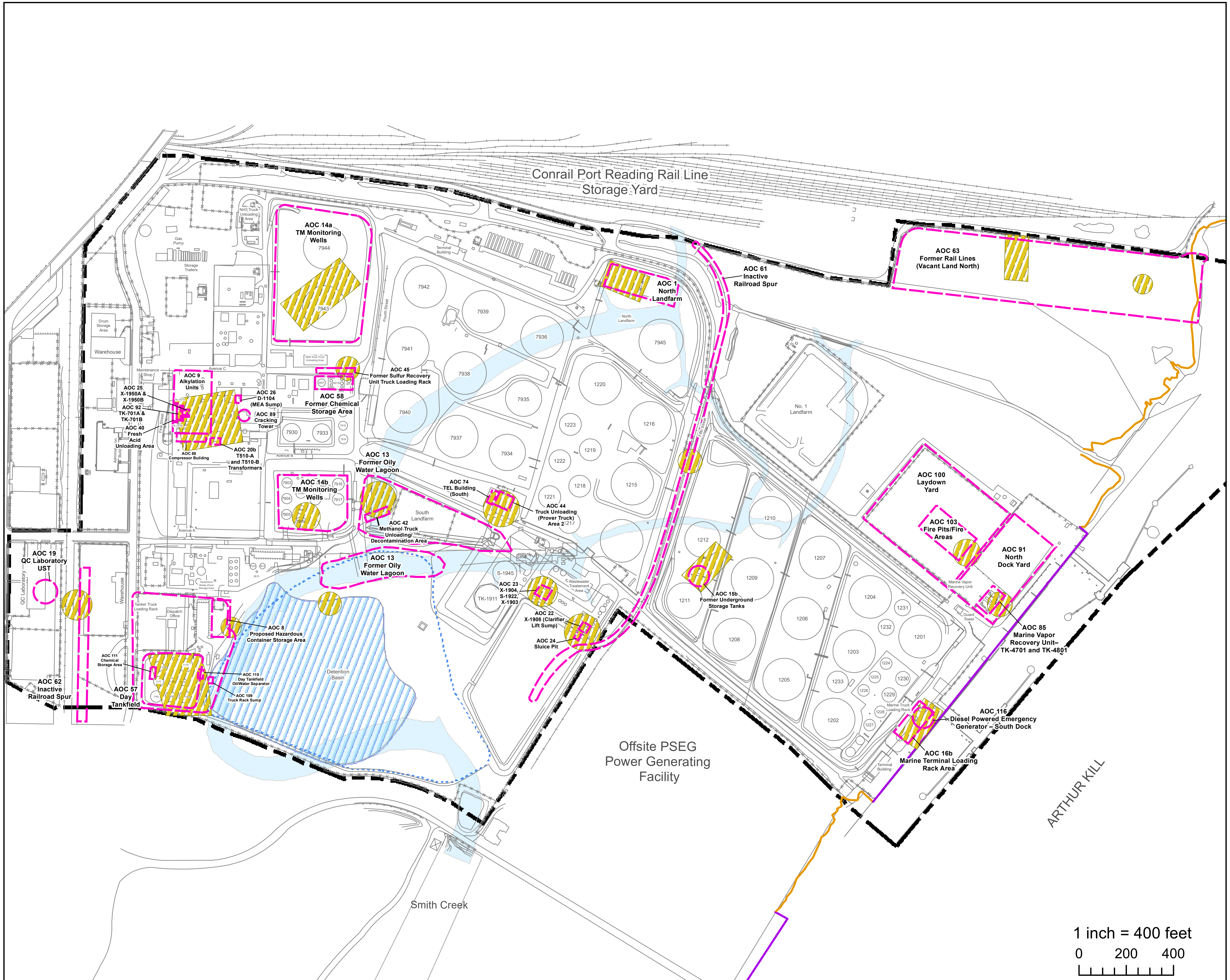

LEGEND

N

- Approximate Hot Spot Boundary for SVOCs in Soil
- Area of Concern Boundary
- Site Boundary
- AOC 12 Extent
- Detention Basin Present Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

Notes:

Hot Spot = Site location with soils exceeding Residential Direct Contact Soil Remediation Standard [RDCSRS], Non-Residential Direct Contact Soil Remediation Standard [NRDSRS]

SVOCs = Semi Volatile Organic Compounds

FIGURE: 6.3
Sitewide Hot Spot Soil Exceedance Map (SVOCs)

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/25/2021
SRP PI#:	006148	**Drawn By:**	AE

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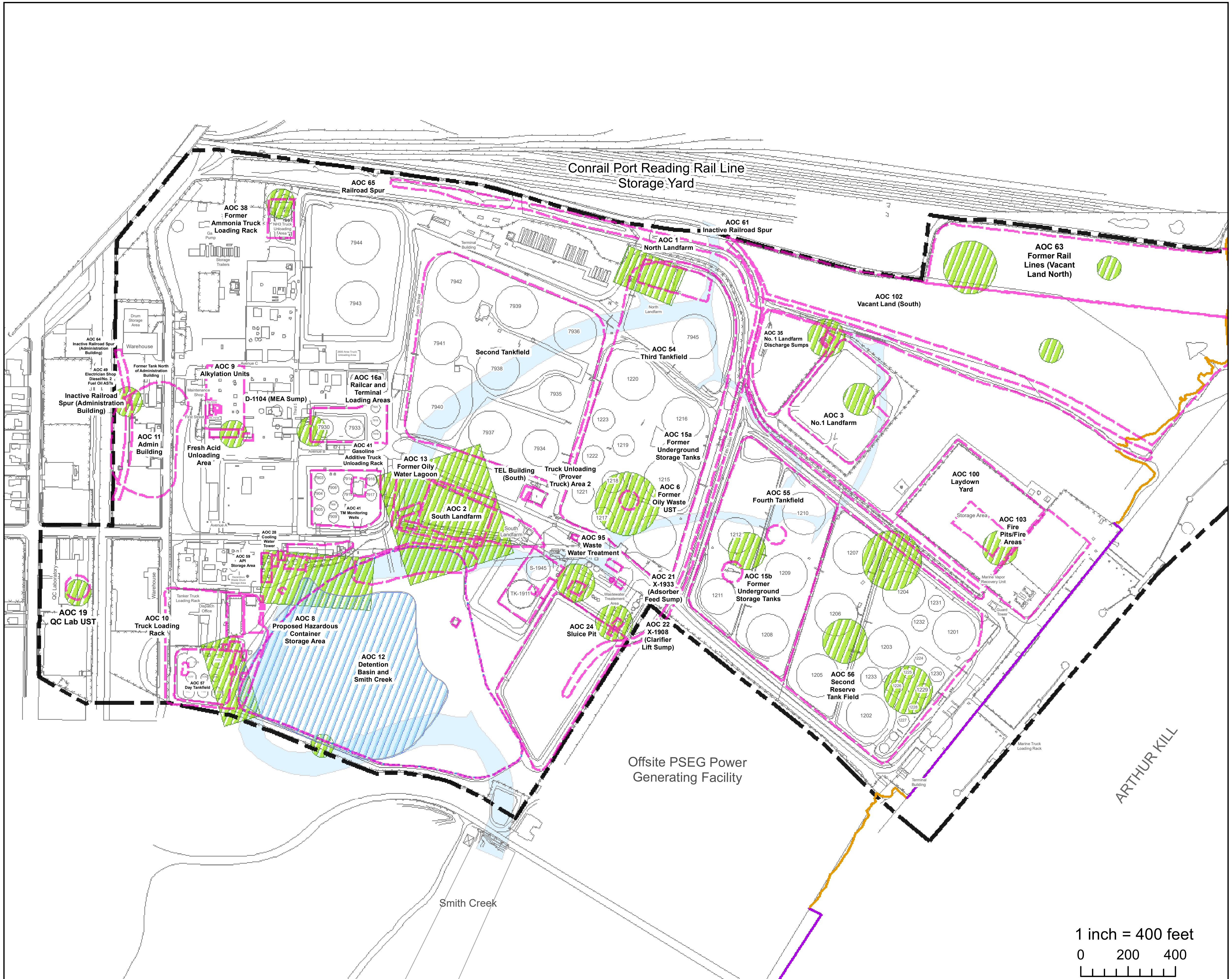

LEGEND

- Approximate Hot Spot Boundary for Metals in Soils
- Area of Concern Boundary
- Site Boundary
- AOC 12 Extent
- Basin Present Extents
- Former Smith Creek Channel
- Shoreline
- Bulkhead

N

Notes:

Hot Spot = Site location with soils exceeding Residential Direct Contact Soil Remediation Standard [RDCSRS], Non-Residential Direct Contact Soil Remediation, Standard [NRDCSRS]]

FIGURE: 6.4
SITEWIDE HOT SPOT SOIL MAP METAL EXCEEDANCES

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	Drawn:	2/24/2021
SRP PI#:	006148	Drawn By:	AE

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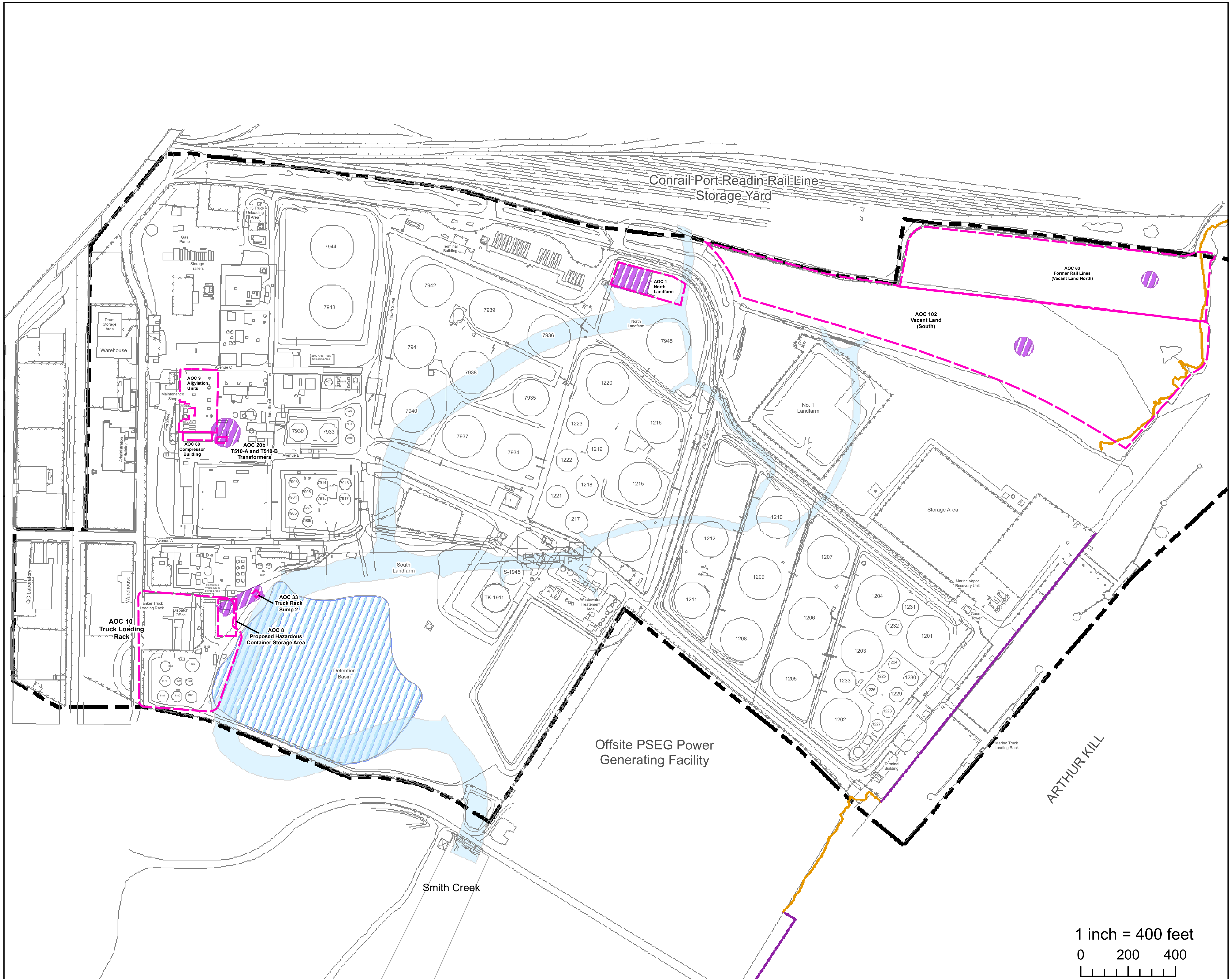

LEGEND

N

- Approximate Hot Spot Boundary For PCBs in Soil
- Area of Concern
- Site Boundary
- Former Smith Creek Channel
- Detention Basin Present Extents
- Bulkhead
- Shoreline

Notes:

Exceedance Areas = Site Locations with soils exceeding Residential Direct Contact Soil Remediation Standard [RDCSRS] or Non-Residential Direct Contact Soil Remediation Standard [NRDCSRS]

PCB= Polychlorinated Biphenyls

FIGURE: 6.5

SITEWIDE HOT SPOT SOIL MAP PCB EXCEEDANCES

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/24/2021
SRP PI#:	006148	**Drawn By:**	AE

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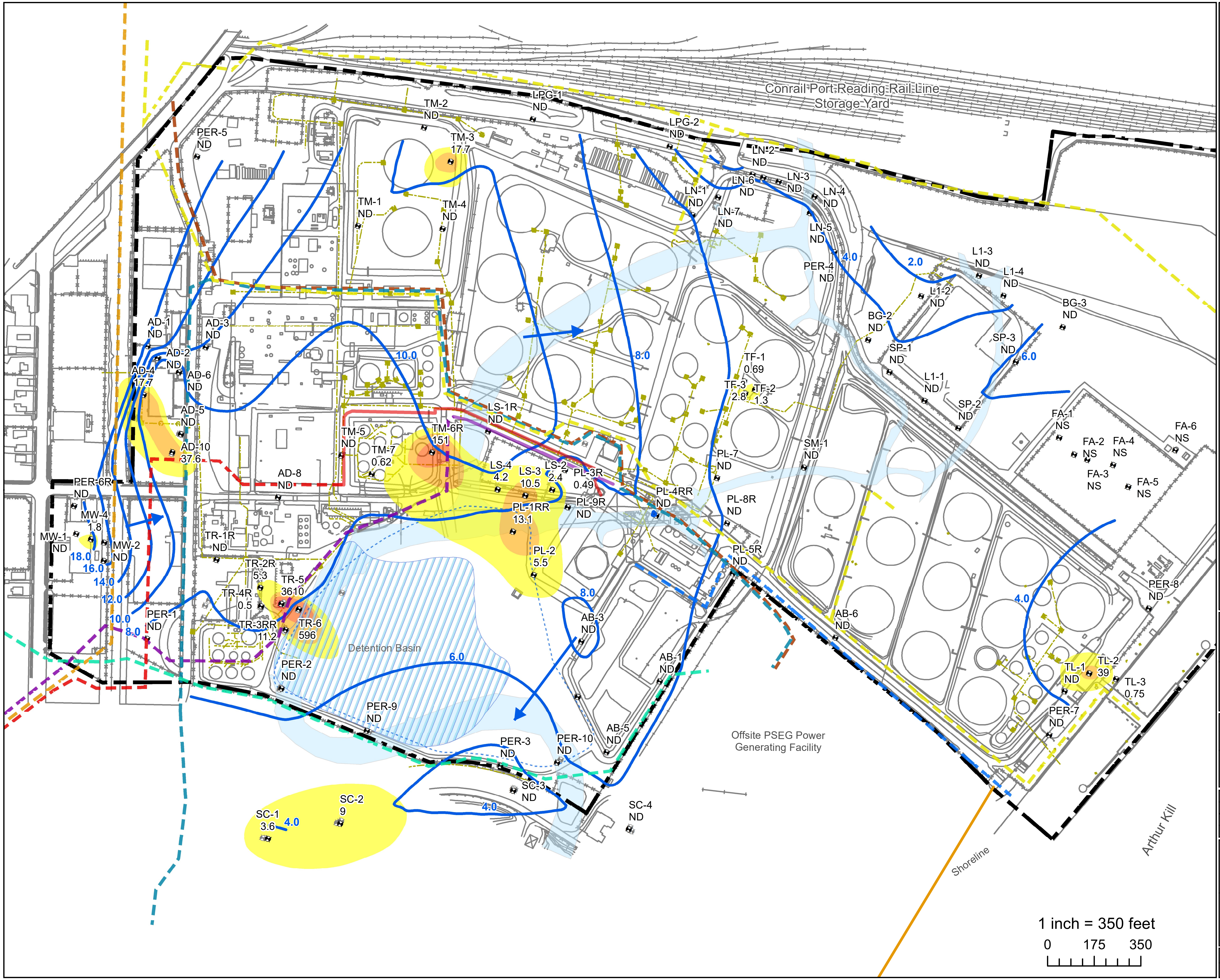

LEGEND

- Shallow Monitoring Well
- Monitoring Well
- Former Smith Creek
- Shoreline
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

Benzene Concentration (ug/l)

- < 1
- 1-10
- 10-100
- 100-1,000
- > 1,000

Well ID
Benzene Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Underground Utility Lines/ Storm Water System

ND: Non-Detect
NS: Not-Sampled

NJ Groundwater Criteria	
Benzene	1

FIGURE: 7.1

November 2019
Groundwater Benzene Map
Screened Interval: 0-20' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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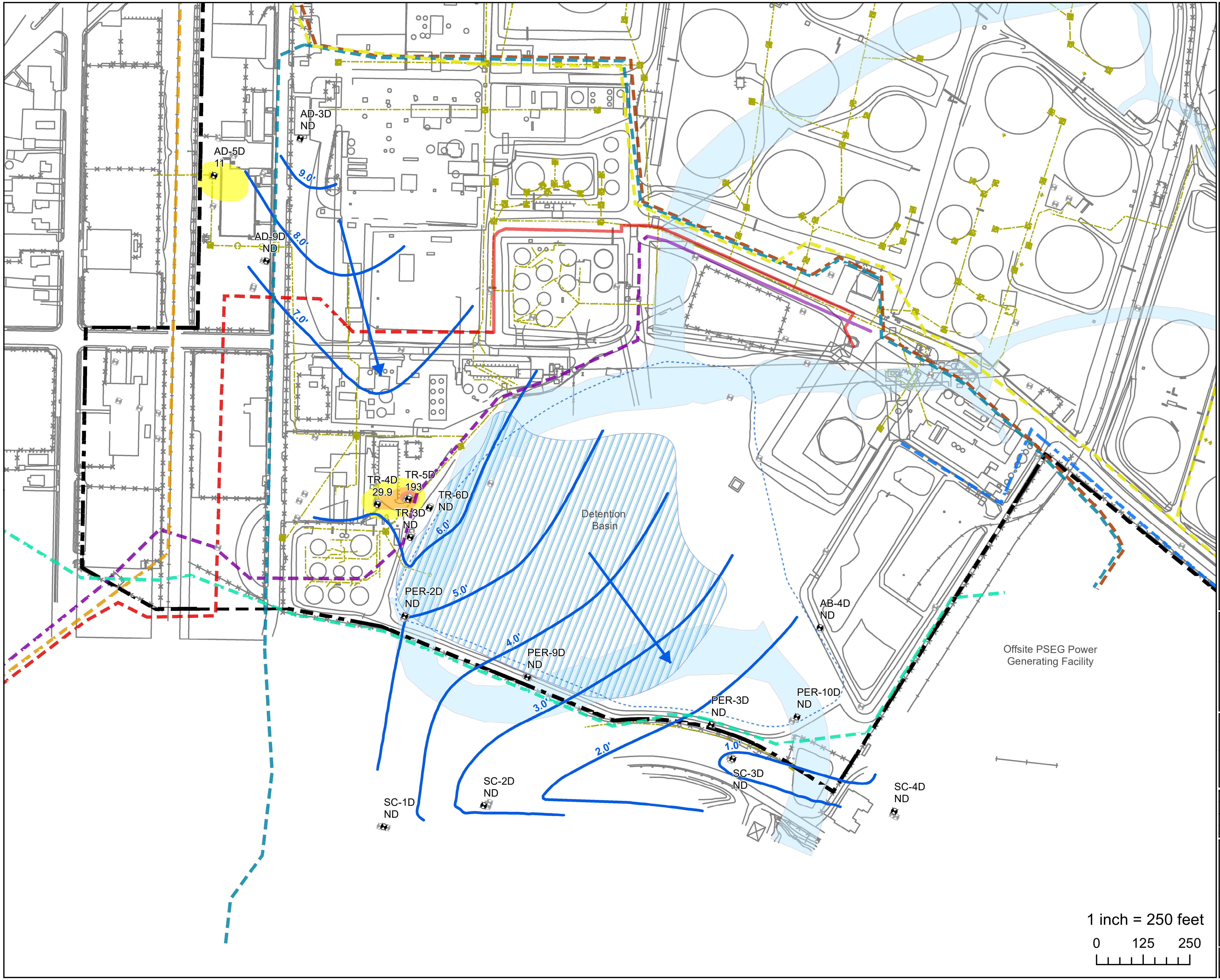

LEGEND

N

- Intermediate Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

Benzene Concentration (ug/l)

- > 1
- 1-10
- 10-100

Well ID
Benzene Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
Benzene	1

FIGURE: 7.2

November 2019
Groundwater Benzene Map
Screened Interval: 20-40' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/24/2021
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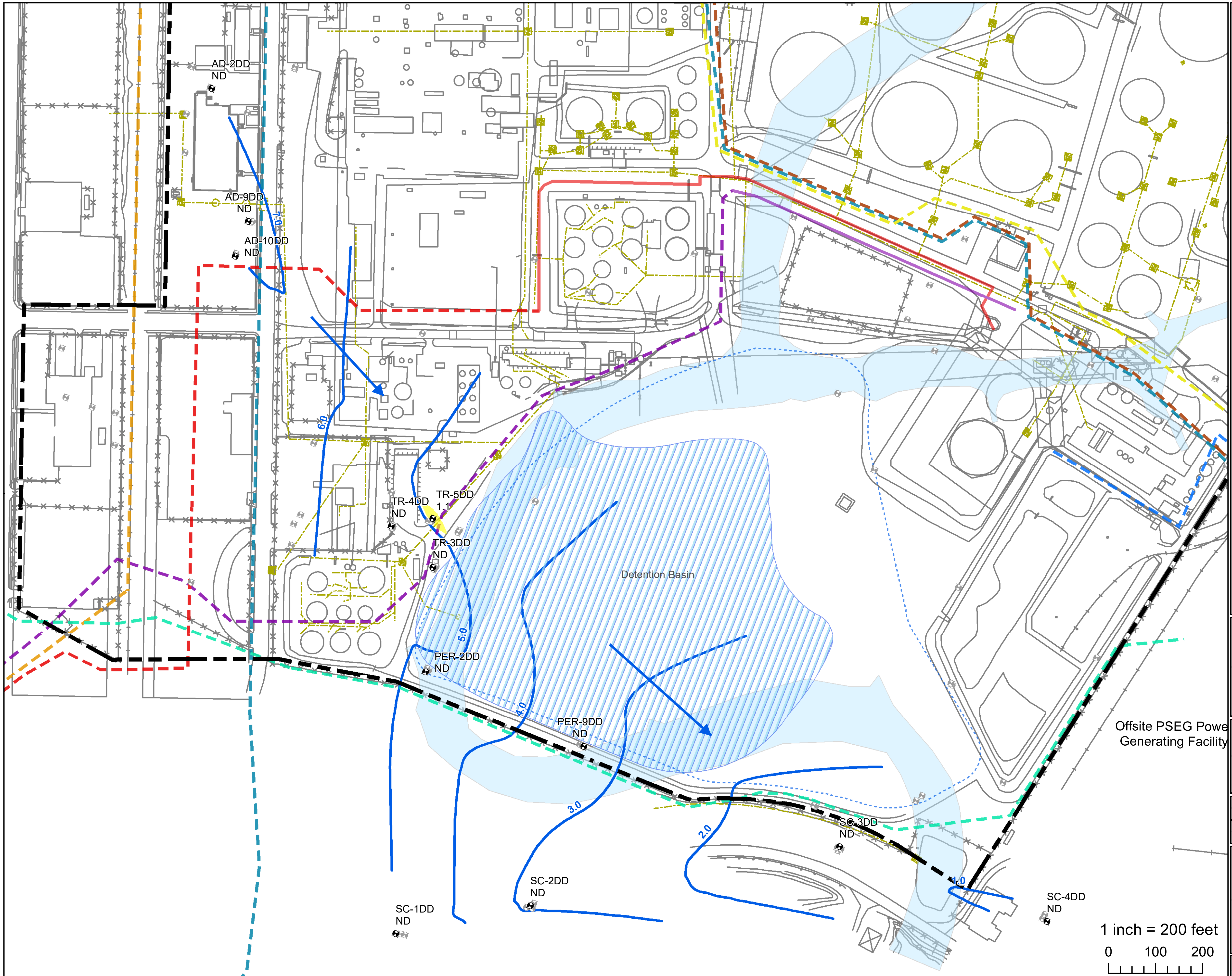

LEGEND

N

- Deep Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

Benzene Concentration (ug/l) Benzene Concentration in ug/L

- < 1
- > 1

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
Benzene	1

FIGURE: 7.3
November 2019
Groundwater Benzene Map
Screened Interval: 40-60' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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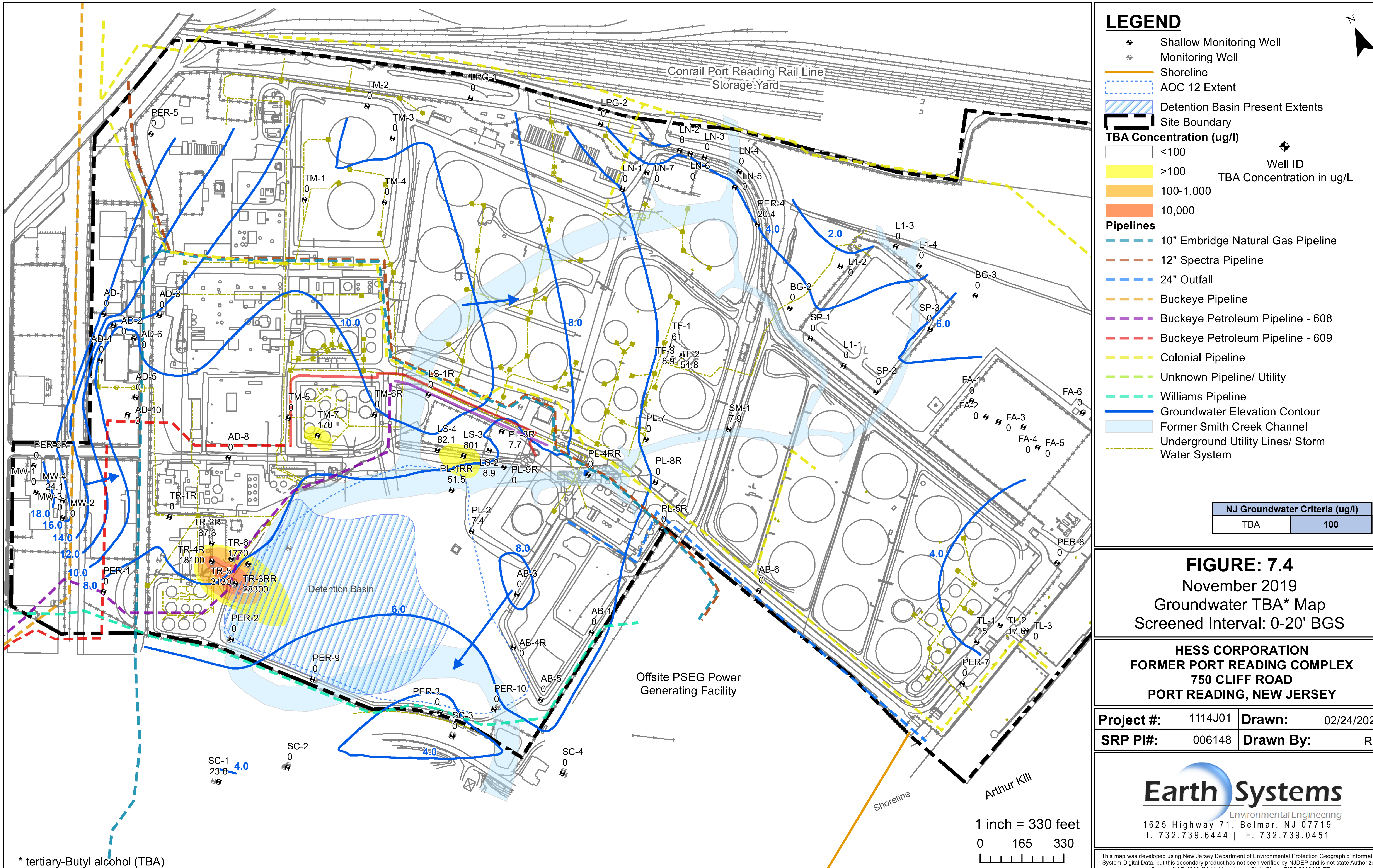

FIGURE: 7.4
November 2019
Groundwater TBA* Map
Screened Interval: 0-20' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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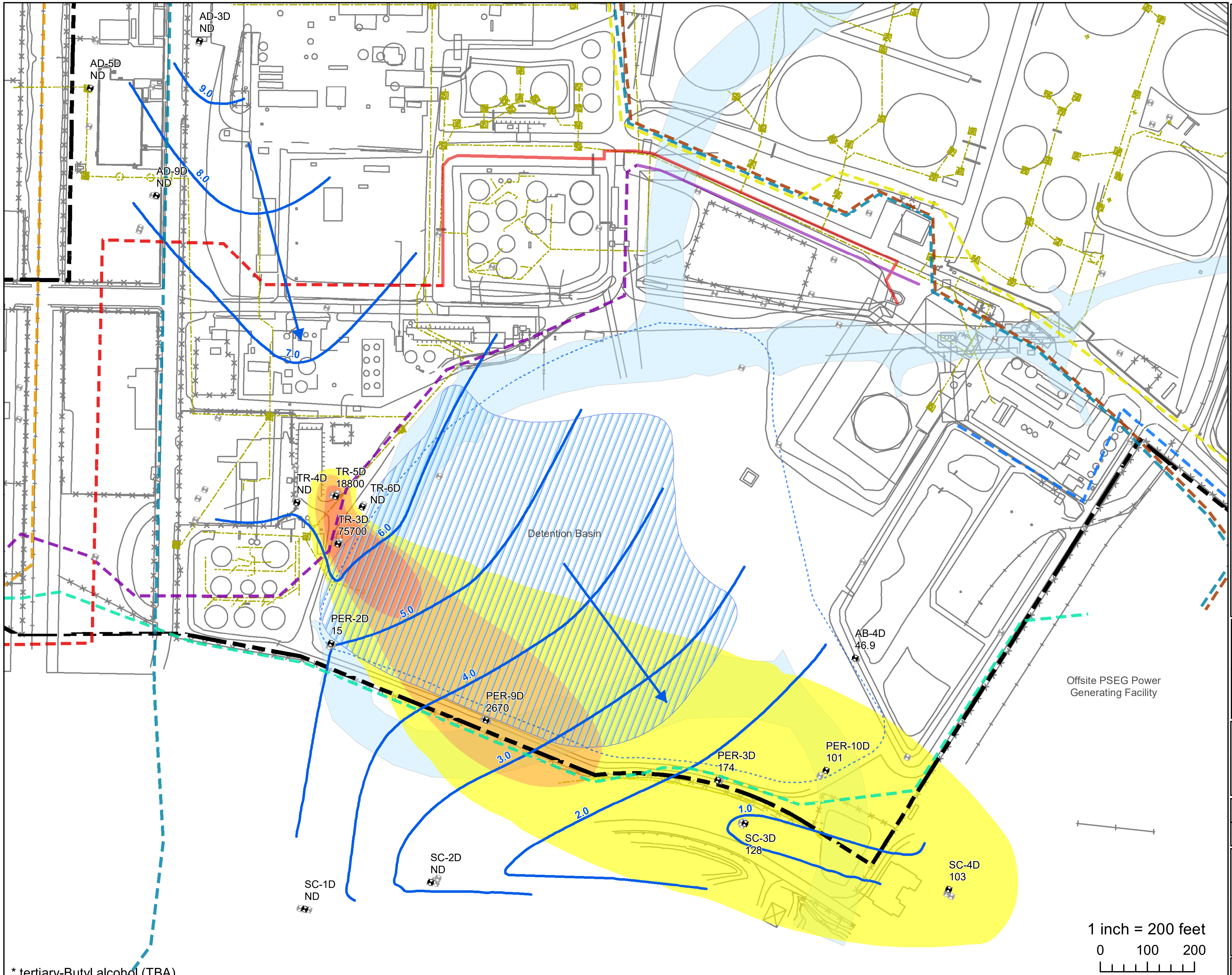

* tertiary-Butyl alcohol (TBA)

LEGEND

- Intermediate Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

TBA Concentration (ug/l)

- <100
- 100-1,000
- 1000-10,000
- >10,000

Well ID
TBA Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
TBA	100

FIGURE: 7.5

November 2019
Groundwater TBA* Map
Screened Interval: 20-40' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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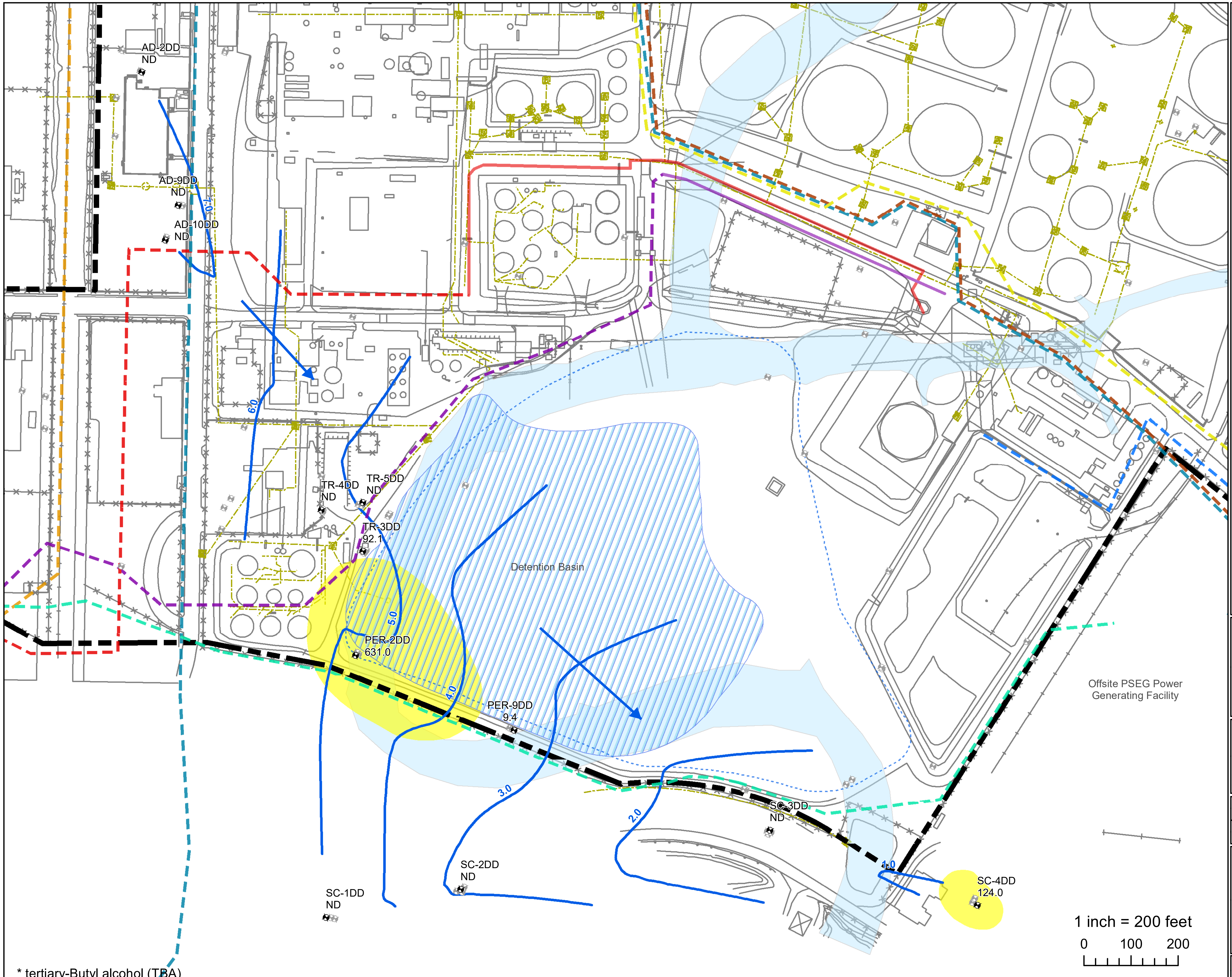

LEGEND

- Deep Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Basin Present Extents
- Site Boundary

TBA Concentration (ug/l)

- <100
- >100

Well ID
TBA Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

N

NJ Groundwater Criteria	
TBA	100

FIGURE: 7.6
November 2019
Groundwater TBA* Map
Screened Interval: 40-60' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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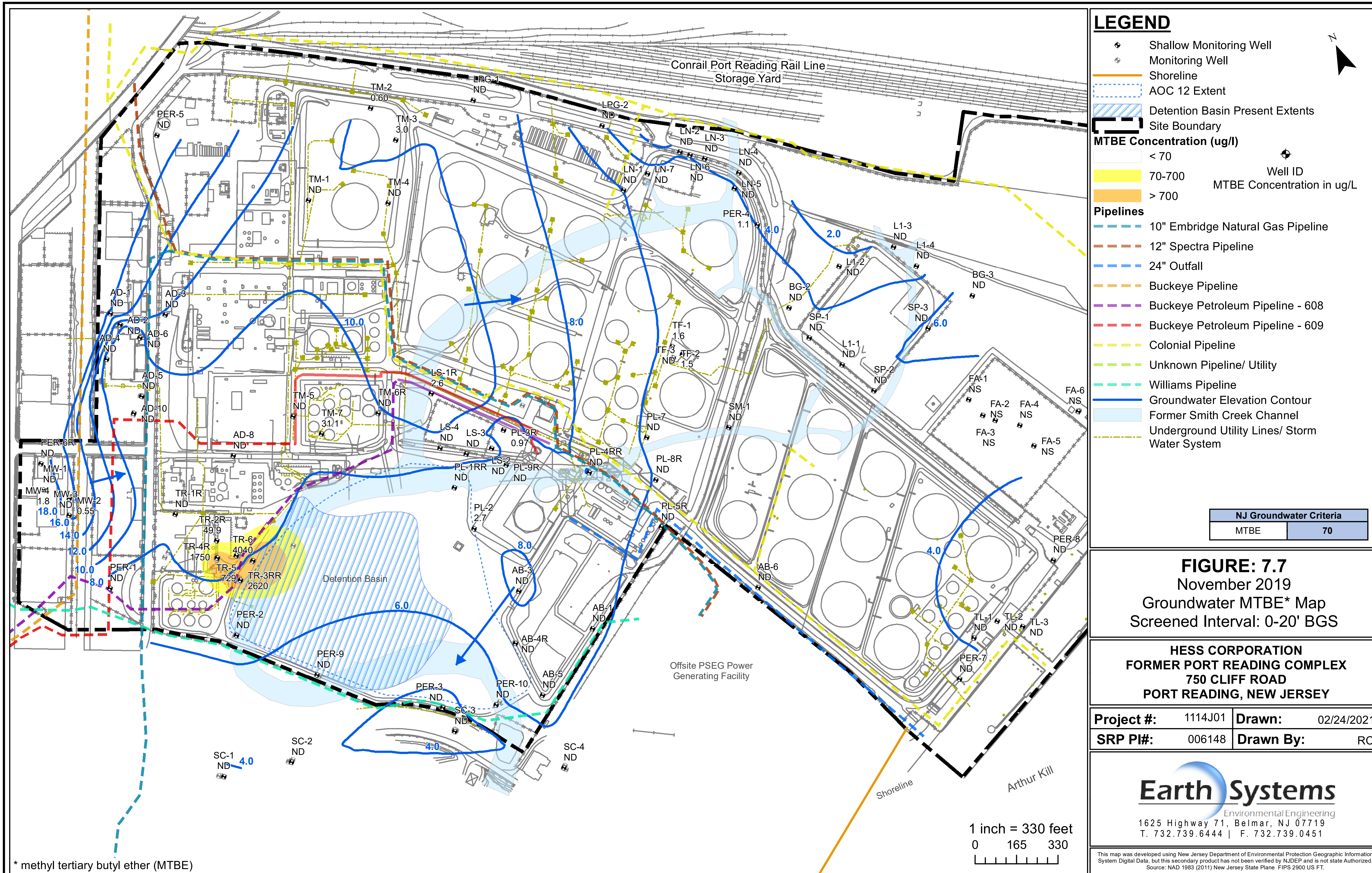
LEGEND
Shallow Monitoring Well
Monitoring Well
Shoreline
AOC 12 Extent
Detention Basin Present Extents
Site Boundary
MTBE Concentration (ug/l)
< 70
70-700
> 700
Well ID
MTBE Concentration in ug/L
Pipelines
10" Embridge Natural Gas Pipeline
12" Spectra Pipeline
24" Outfall
Buckeye Pipeline
Buckeye Petroleum Pipeline - 608
Buckeye Petroleum Pipeline - 609
Colonial Pipeline
Unknown Pipeline/ Utility
Williams Pipeline
Groundwater Elevation Contour
Former Smith Creek Channel
Underground Utility Lines/ Storm Water System
N
NJ Groundwater Criteria
MTBE 70
FIGURE: 7.7
November 2019
Groundwater MTBE* Map
Screened Interval: 0-20' BGS
HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY
Project #: 1114J01
Drawn: 02/24/2021
SRP PI#: 006148
Drawn By: RC
Earth Systems
Environmental Engineering
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451
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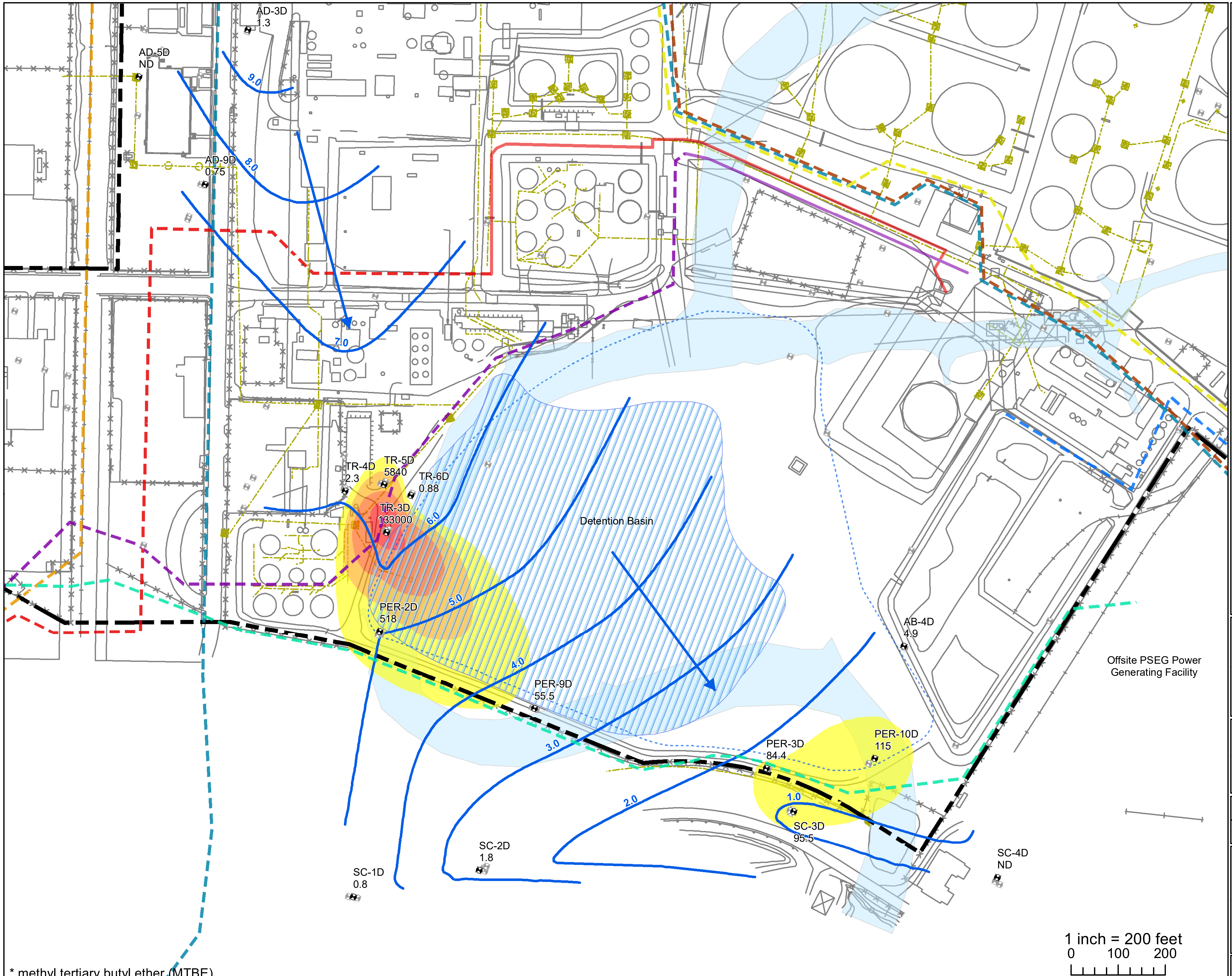
Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.
1 inch = 330 feet
0 165 330
Conrail Port Reading Rail Line
Storage Yard
Detention Basin
Offsite PSEG Power Generating Facility
Shoreline
Arthur Kill
TM-2 0.60
LPG-1 ND
LPG-2 ND
TM-3 3.0
PER-5 ND
TM-1 ND
TM-4 ND
LN-2 ND
LN-3 ND
LN-4 ND
LN-1 ND
LN-7 ND
LN-6 ND
LN-5 ND
PER-4 1.1
L1-3 ND
L1-4 ND
L1-2 ND
BG-2 ND
BG-3 ND
SP-3 ND
SP-1 ND
L1-1 ND
SP-2 ND
AD-1 ND
AD-3 ND
AD-2 ND
AD-6 ND
AD-4 ND
AD-5 ND
AD-10 ND
AD-8 ND
TF-1 1.6
TF-3 ND
TF-2 1.5
LS-1R 2.6
TM-5 ND
TM-6R ND
TM-7 31.1
LS-4 ND
LS-3 ND
PL-3R 0.97
PL-7 ND
SM-1 ND
FA-1 NS
FA-2 NS
FA-4 NS
FA-6 NS
FA-3 NS
FA-5 NS
PER-6R ND
MW-1 ND
MW-4 1.8
MW-3 ND
MW-2 0.55
TR-1R ND
PL-1RR ND
LS-2 ND
PL-9R ND
PL-4RR ND
PL-8R ND
PL-2 2.7
PL-5R ND
TR-2R 49.9
TR-6 4040
TR-4R 1750
TR-5 729
TR-3RR 2620
PER-1 ND
AB-3 ND
AB-6 ND
PER-8 ND
AB-1 ND
PER-2 ND
AB-4R ND
TL-1 ND
TL-2 ND
TL-3 ND
PER-9 ND
AB-5 ND
PER-7 ND
PER-10 ND
PER-3 ND
SC-3 ND
SC-2 ND
SC-1 ND
SC-4 ND
10.0
8.0
6.0
4.0
2.0
18.0
16.0
14.0
12.0
* methyl tertiary butyl ether (MTBE)



LEGEND

- Intermediate Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

MTBE Concentration (ug/l)

- < 70
- 70-700
- 700-7,000
- 7,000-70,000
- > 70,000

Well ID
MTBE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
MTBE	70

FIGURE: 7.8

November 2019
Groundwater MTBE* Map
Screened Interval: 20-40' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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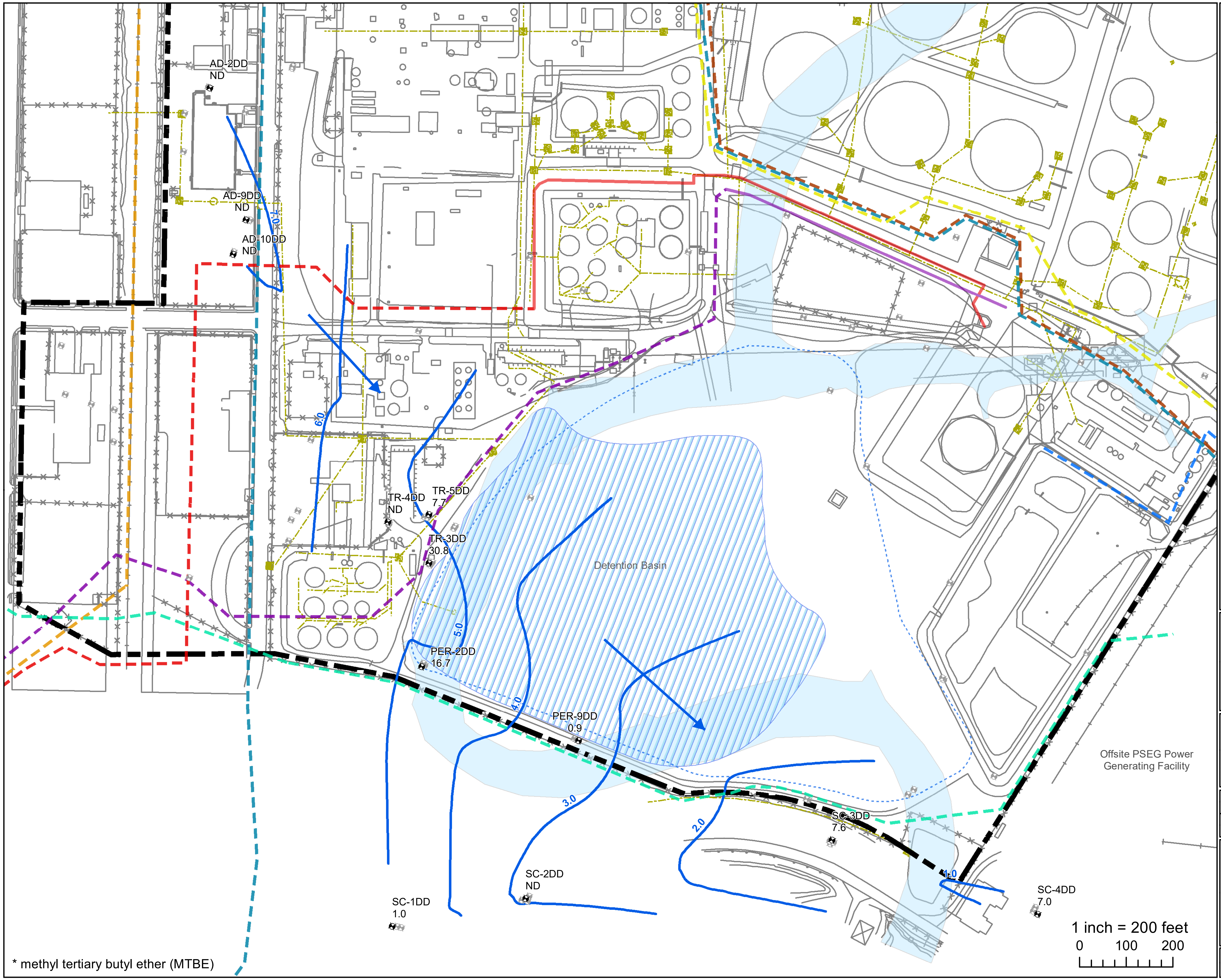

LEGEND

- Deep Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

MTBE Concentration (ug/l)

- < 70

MTBE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
MTBE	70

FIGURE: 7.9

November 2019
Groundwater MTBE* Map
Screened Interval: 40-60' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/19/2021
SRP PI#:	006148	**Drawn By:**	RC

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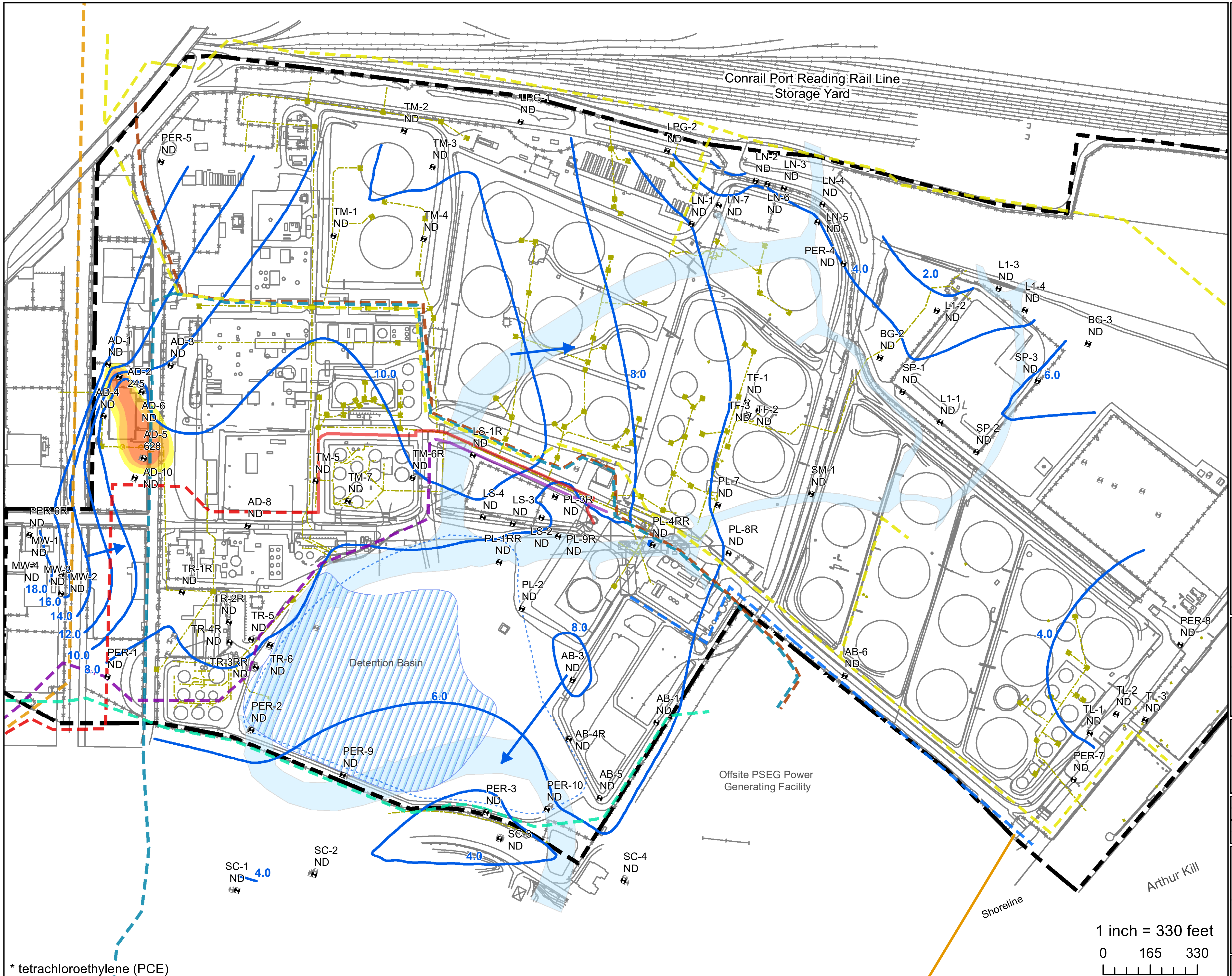

LEGEND

- Shallow Monitoring Well
- Monitoring Well
- Shoreline
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

PCE Concentration (ug/l)

- < 1
- 1-10
- 10-100
- > 100

Well ID
PCE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
PCE	1

FIGURE: 7.10

November 2019
Groundwater PCE* Map
Screened Interval: 0-20' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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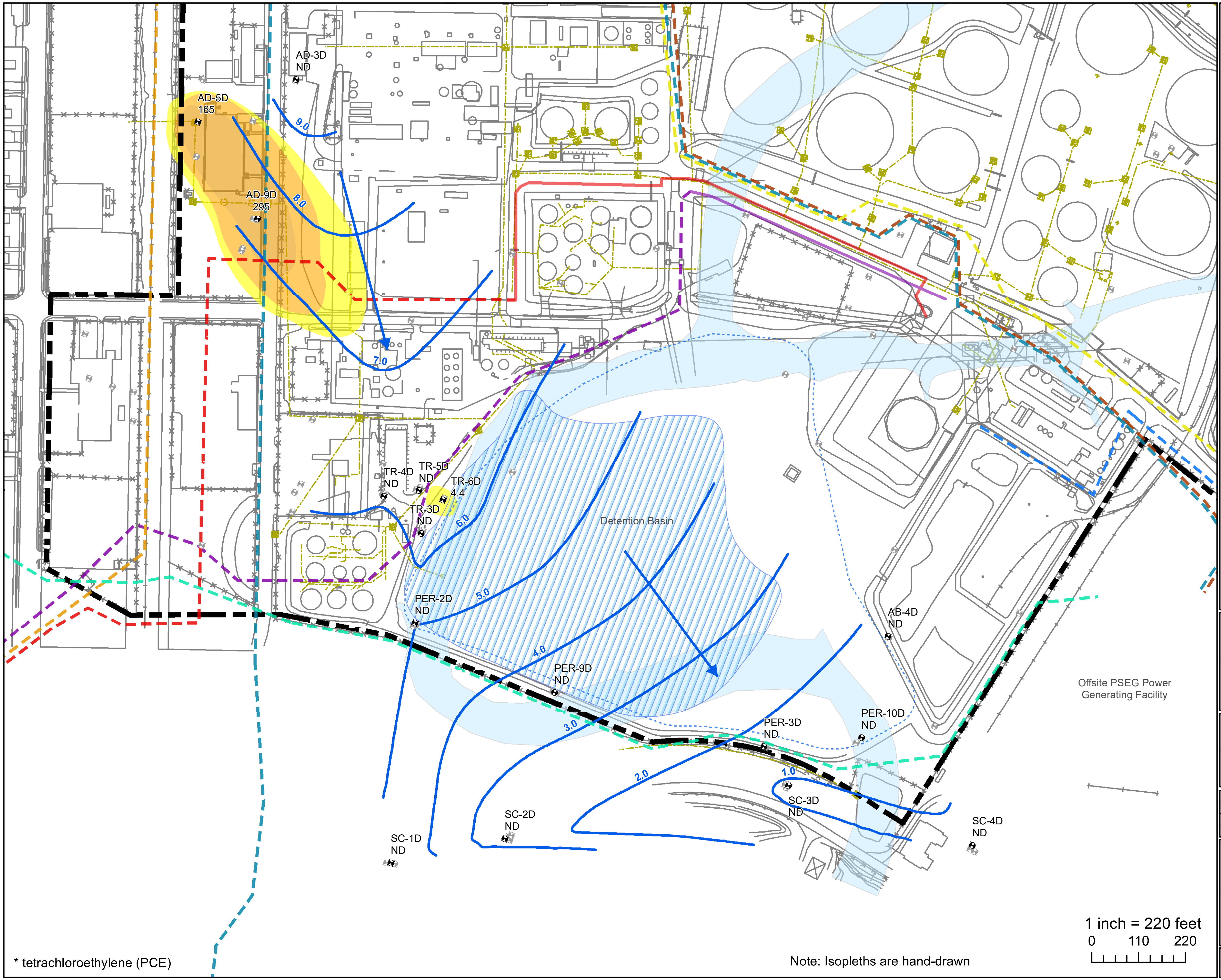

LEGEND

- Intermediate Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Basin Present Extents
- Site Boundary

PCE Concentration (ug/l)

- < 1
- 1-10
- 10-100
- < 100

Well ID
PCE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
PCE	1

FIGURE: 7.11
November 2019
Groundwater PCE* Map
Screened Interval: 20-40' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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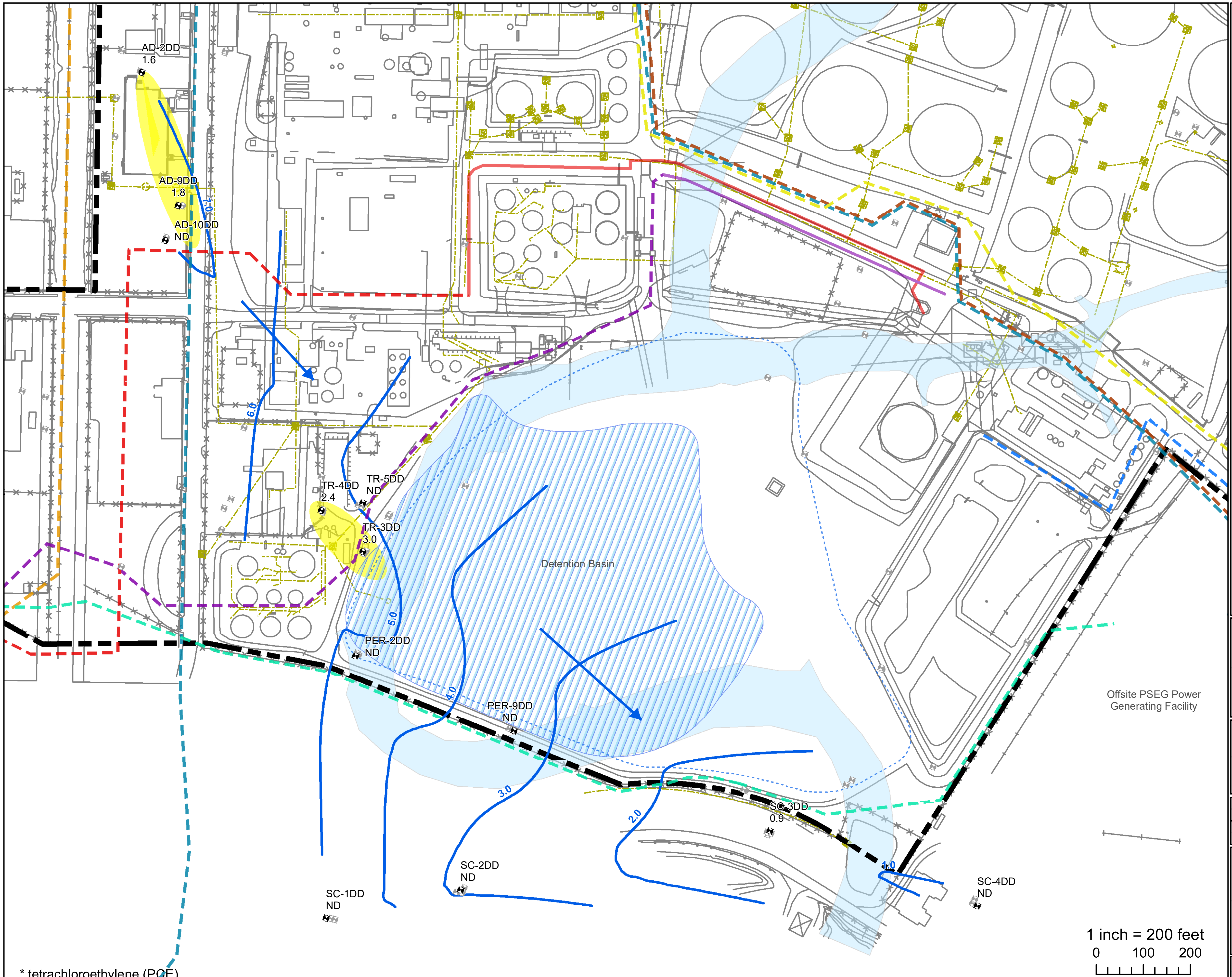

LEGEND

- Deep Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Basin Present Extents
- Site Boundary

Well ID
PCE Concentration in ug/L

PCE Concentration (ug/L)

- < 1
- > 1

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
PCE	1

FIGURE: 7.12

November 2019
Groundwater PCE* Map
Screened Interval: 40-60' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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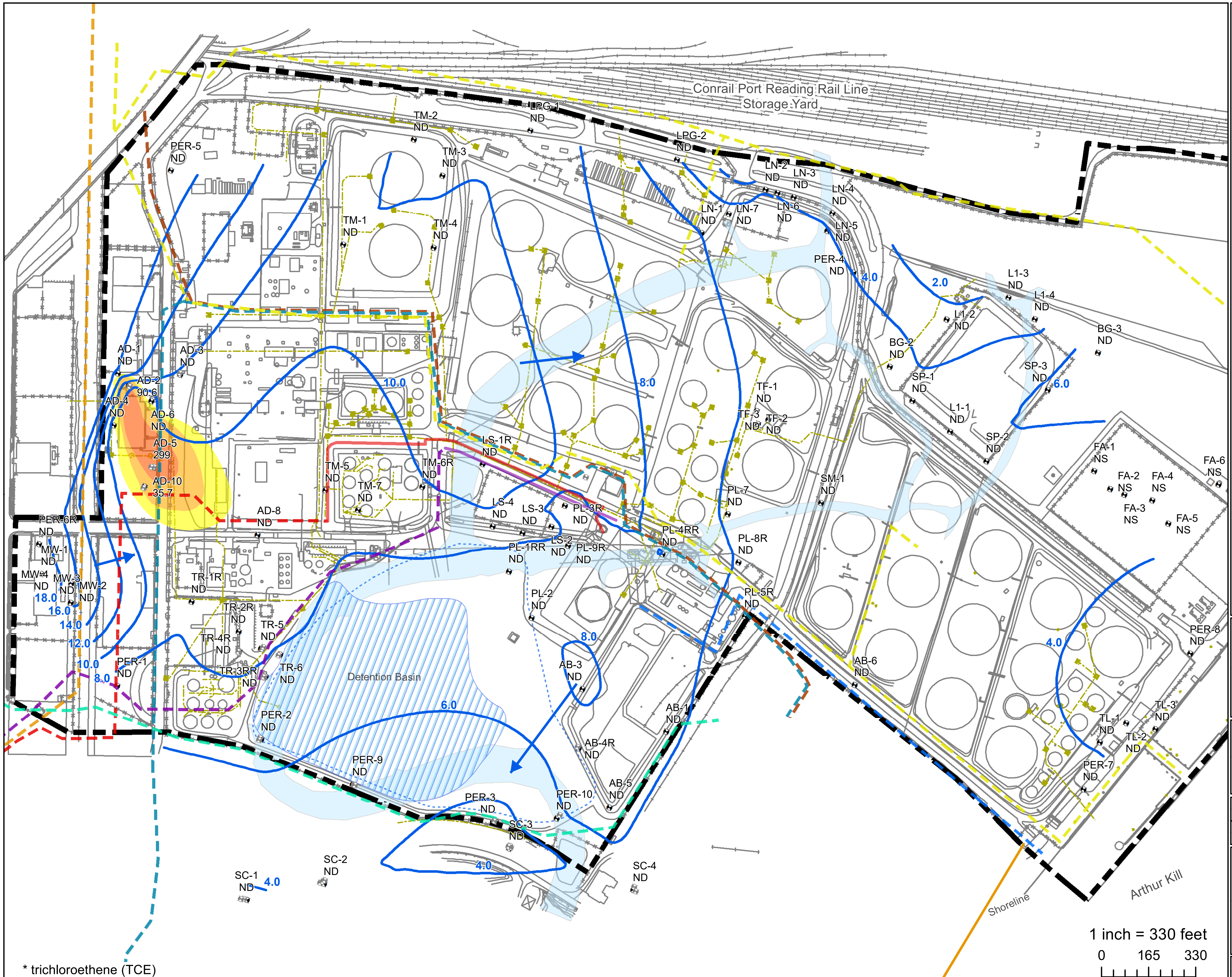

* trichloroethene (TCE)

LEGEND

- Shallow Monitoring Well
- Monitoring Well
- Shoreline
- AOC 12 Extent
- Basin Present Extents
- Site Boundary

TCE Concentration (ug/l)

- < 1
- 1-10
- 10-100
- > 100

Well ID
TCE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
TCE	1

1 inch = 330 feet

0 165 330

FIGURE: 7.13
November 2019
Groundwater TCE* Map
Screened Interval: 0-20' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	Drawn:	02/24/2021
SRP PI#:	006148	Drawn By:	RC

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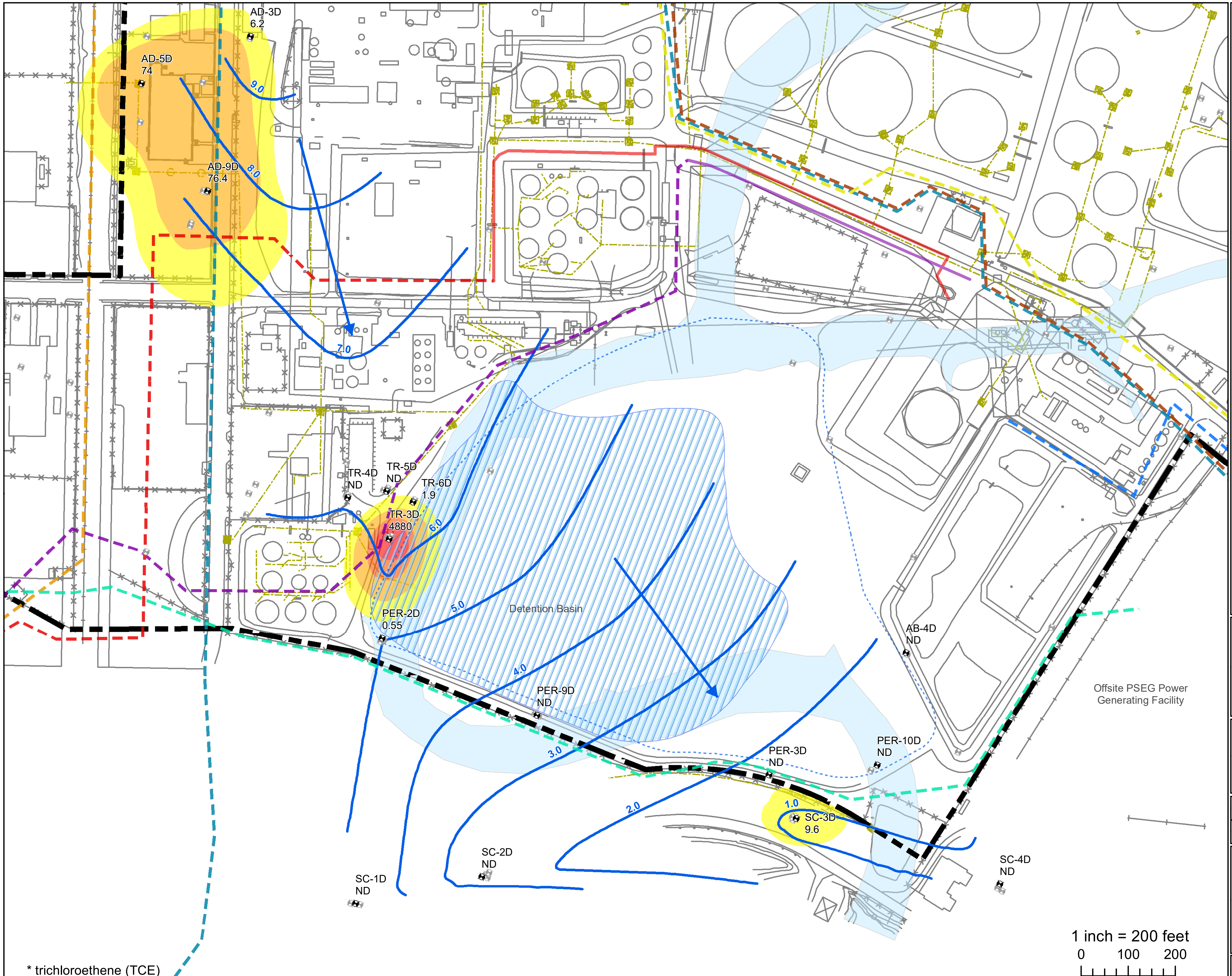

LEGEND

- Intermediate Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

TCE Concentration (ug/l)

- < 1
- 1-10
- 10-100
- 100-1000
- > 1000

Well ID
TCE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
TCE	1

FIGURE: 7.14

November 2019
Groundwater TCE* Map
Screened Interval: 20-40' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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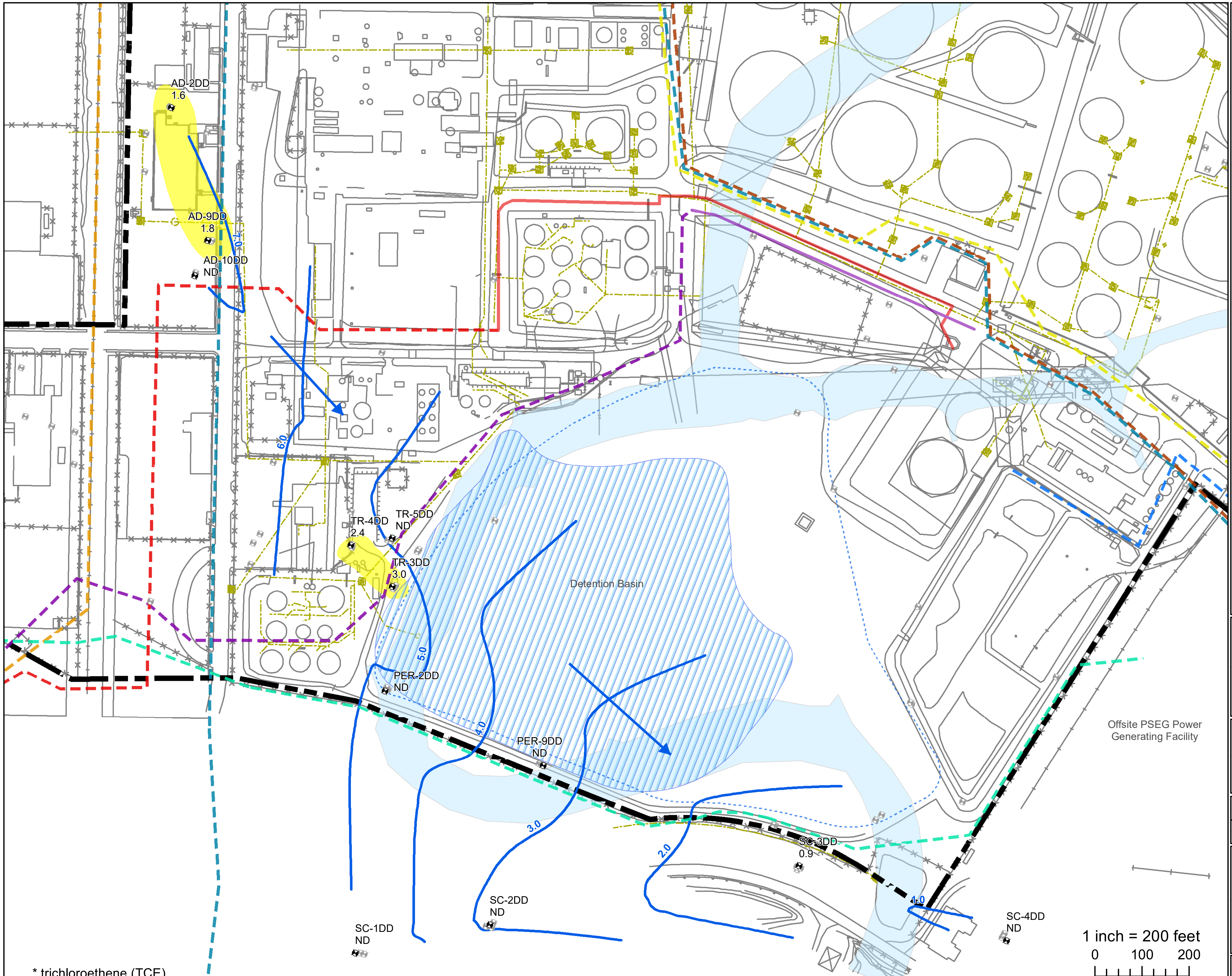
Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.



LEGEND

- Deep Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

TCE Concentration (ug/l)

- < 1
- > 1

Well ID
TCE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
TCE	1

FIGURE: 7.15

November 2019
Groundwater TCE* Map
Screened Interval: 40-60' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
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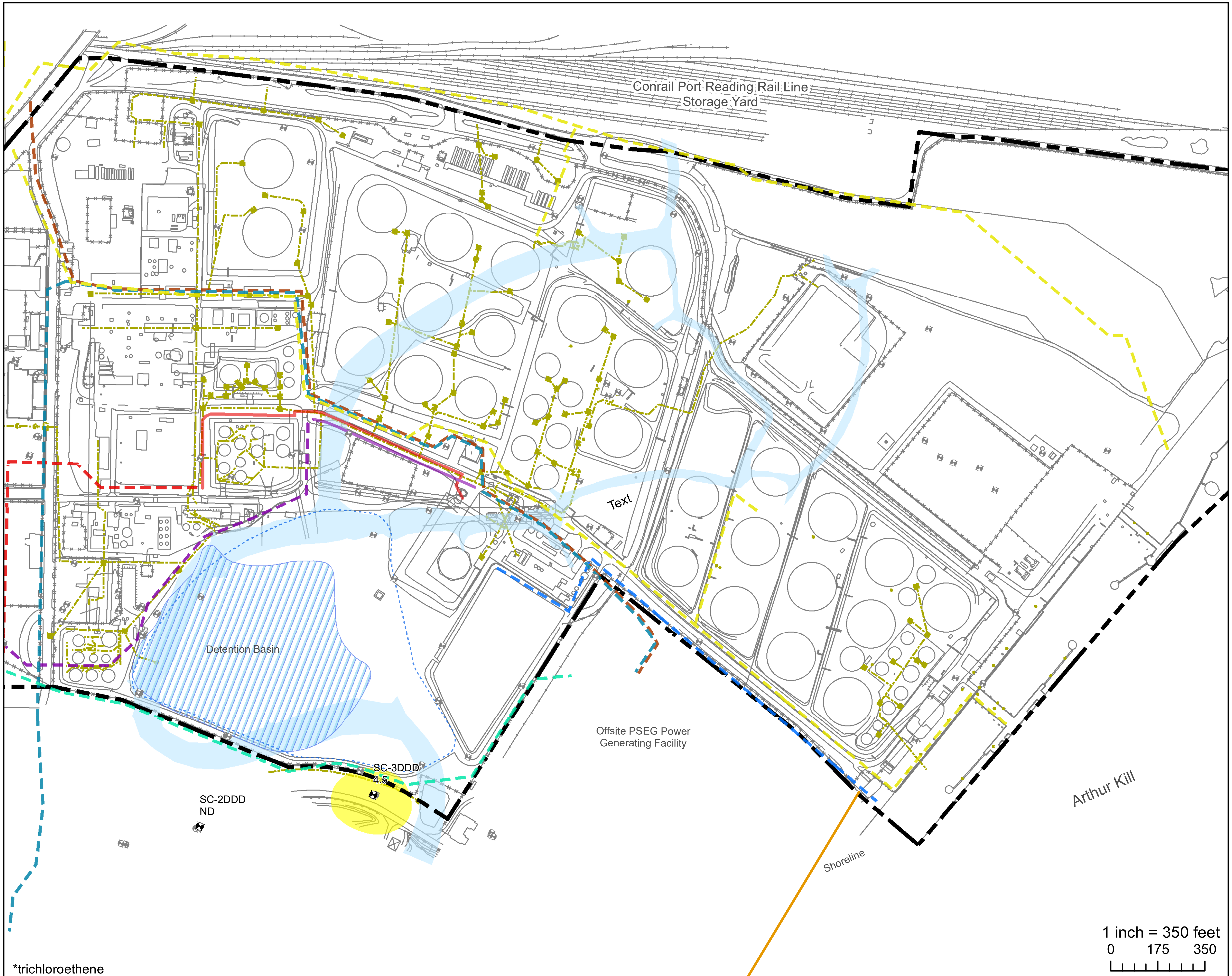

LEGEND

- 60-80' Monitoring Well
- Monitoring Well
- Site Boundary
- Shoreline
- AOC 12 Extent
- Detention Basin Present Extents

TCE Concentration (ug/l)

- < 1
- > 1

Well ID
TCE Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Former Smith Creek Channel
- Underground Utility Lines

NJ Groundwater Criteria	
TCE	1

FIGURE: 7.16

November 2019
Groundwater TCE* Map
Screened Interval: 60-80' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/23/2021
SRP PI#:	006148	**Drawn By:**	RC

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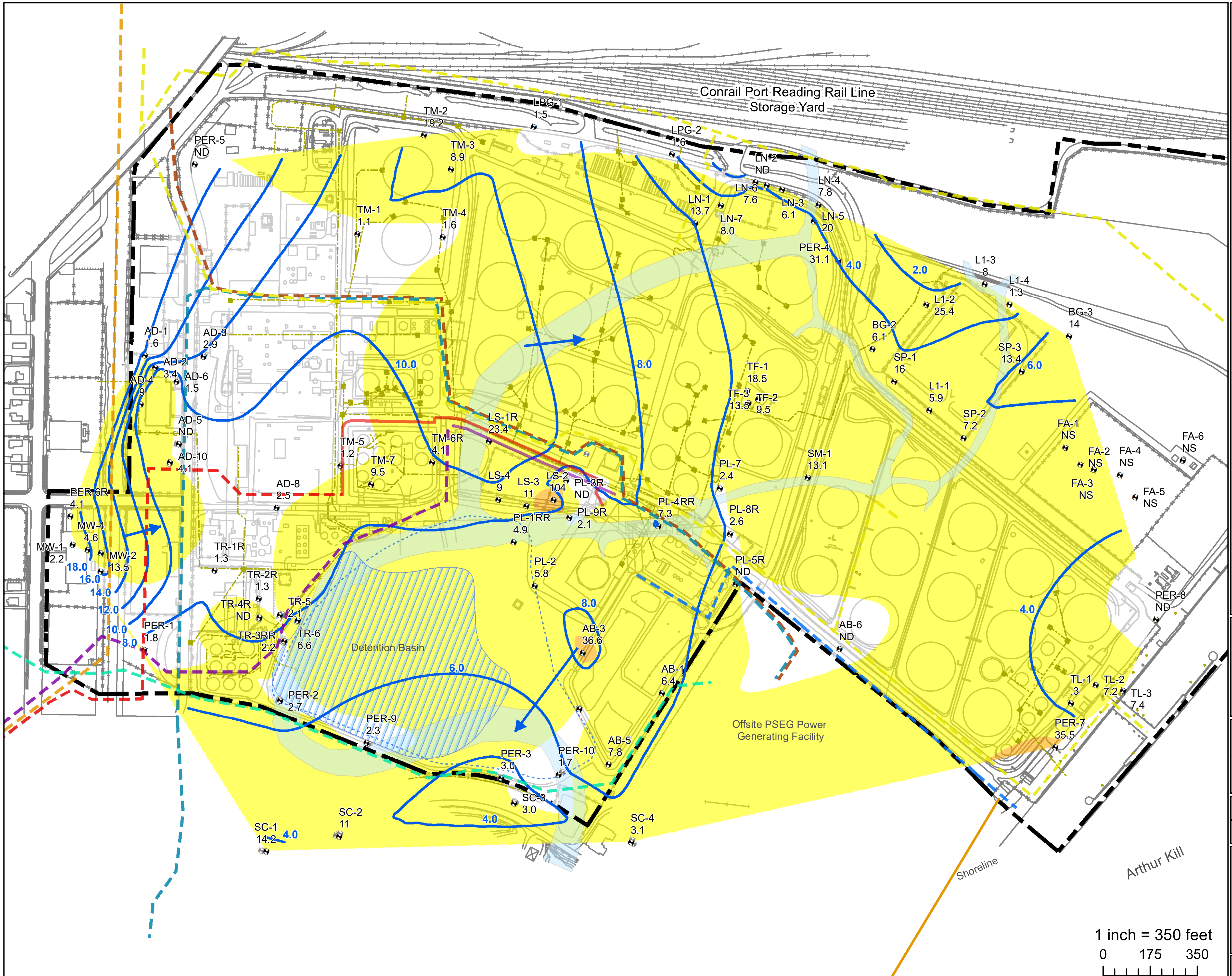

LEGEND

- Shallow Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary
- Shoreline

Arsenic Concentration (ug/l)

- < 3
- 3-30
- 30-300

Well ID
Arsenic Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
Arsenic	3

FIGURE: 7.17

November 2019
Groundwater Arsenic Map
Screened Interval: 0-20' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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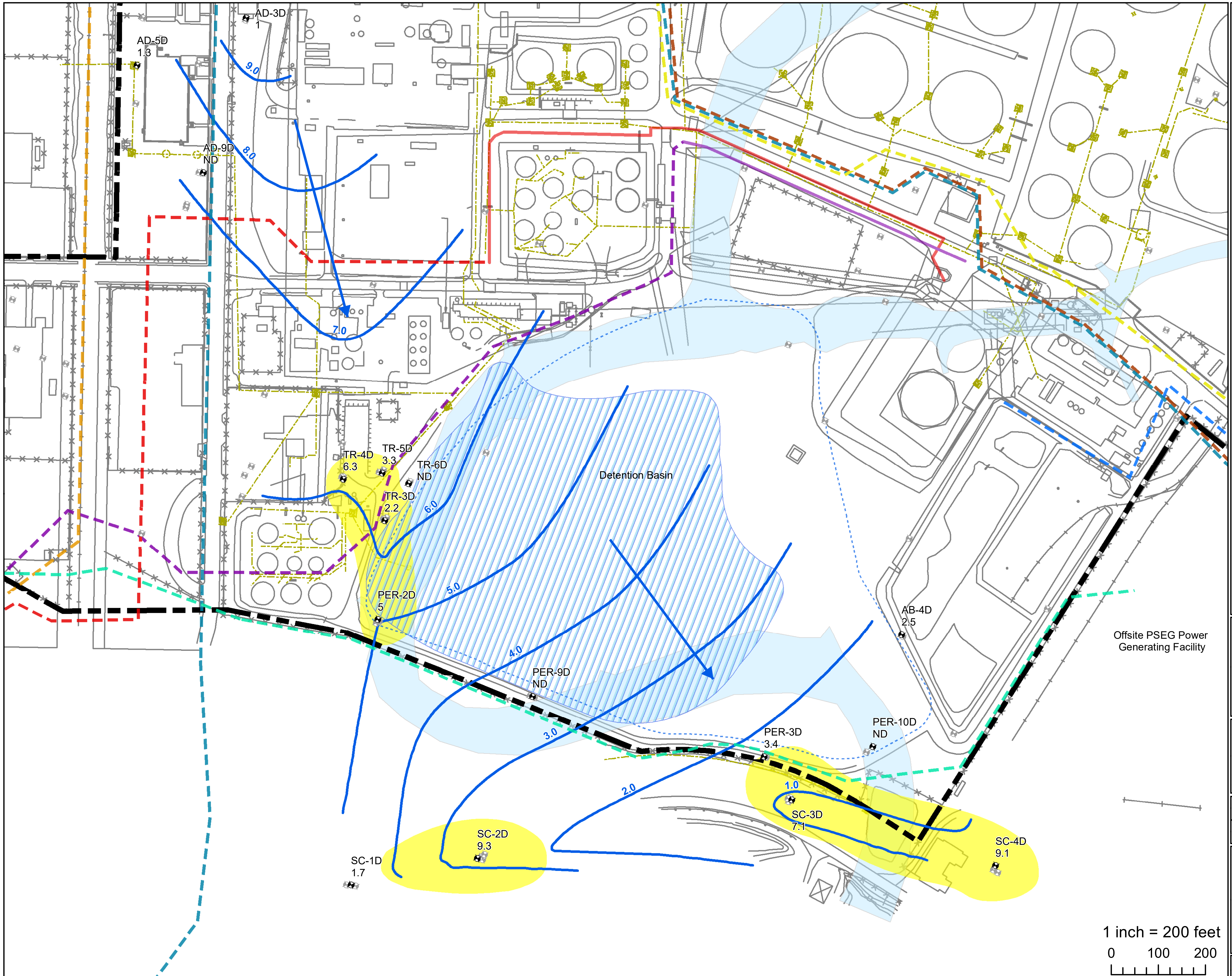

LEGEND

N

- Intermediate Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary

Arsenic Concentration (ug/l)

- < 3
- > 3

Well ID
Arsenic Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- November2019SitewideIntermed...
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
Arsenic	3

FIGURE: 7.18

November 2019
Groundwater Arsenic Map
Screened Interval: 20-40' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	RC

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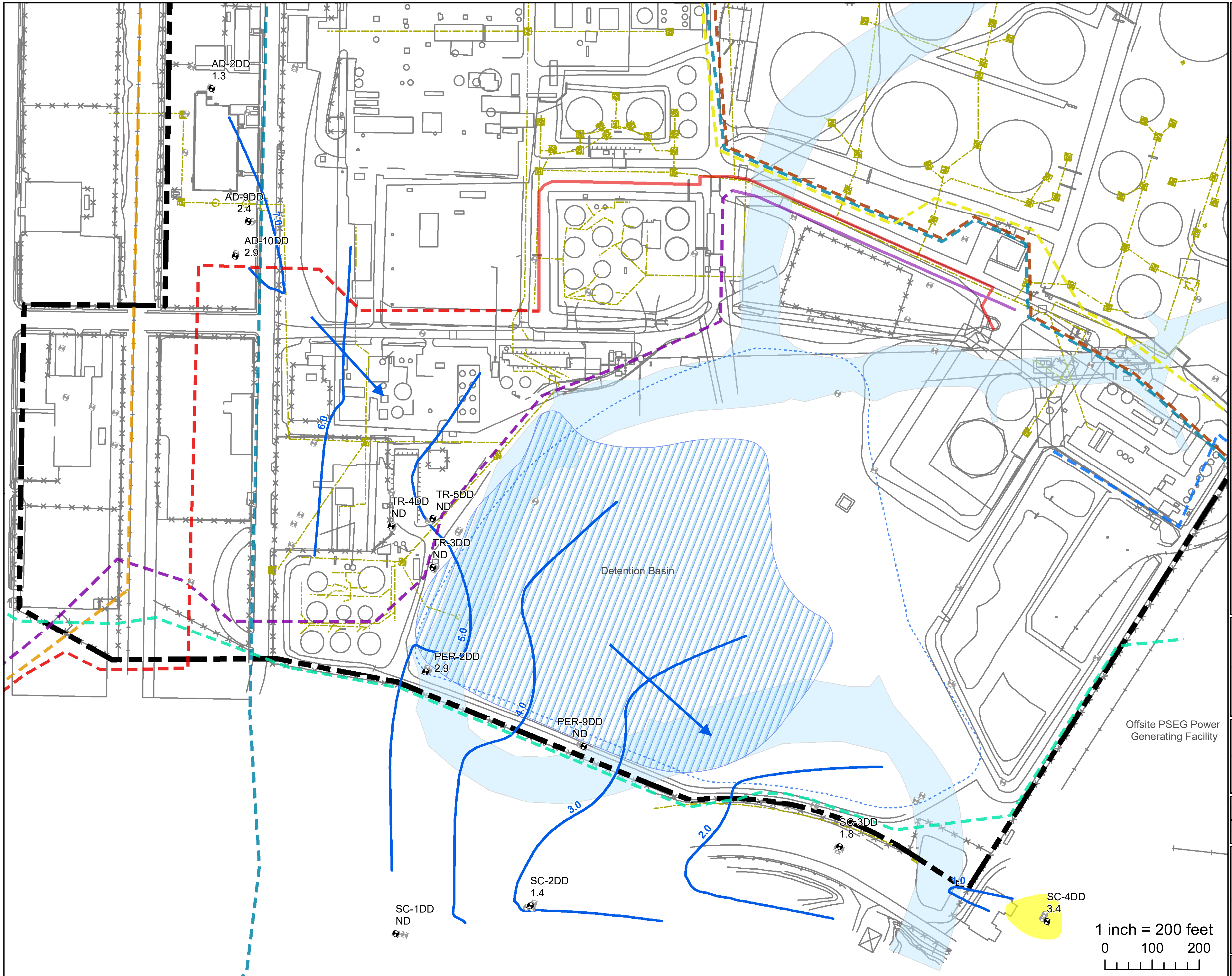

LEGEND

- Deep Monitoring Well
- Monitoring Well
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary
- Former Smith Creek Channel

Arsenic Concentration (ug/l)

- < 3
- > 3

Well ID
Arsenic Concentration in ug/L

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- November2019SitewideDeep
- Underground Utility Lines/ Storm Water System

N

NJ Groundwater Criteria	
Arsenic	3

FIGURE: 7.19

November 2019
Groundwater Arsenic Map
Screened Interval: 40-60' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	Drawn:	02/24/2021
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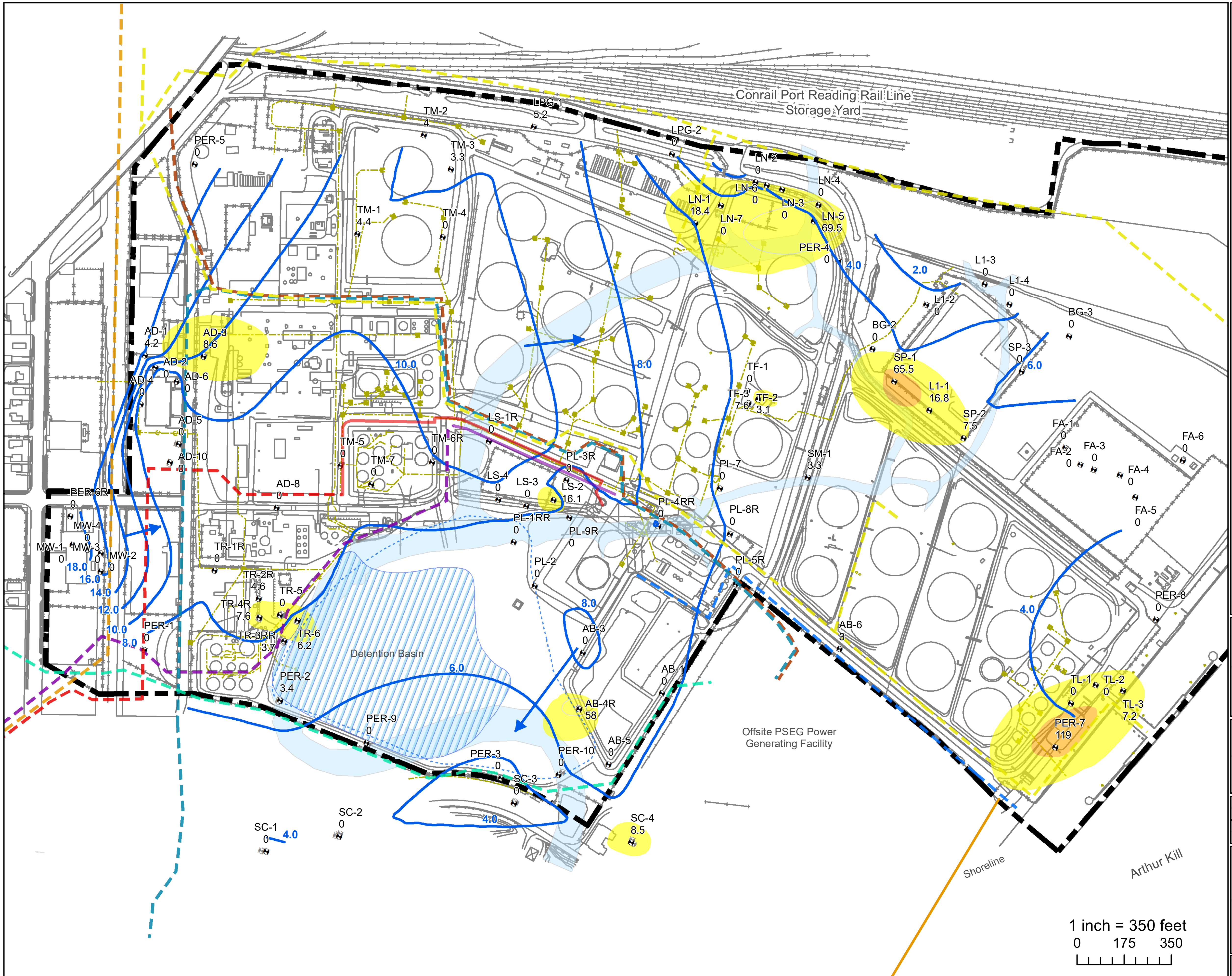

LEGEND

- Shallow Monitoring Well
- Monitoring Well
- Site Boundary
- Shoreline

Well ID
Lead Concentration in ug/L

Lead Concentration (ug/l)

- < 5
- 5-50
- > 50

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline
- Groundwater Elevation Contour
- AOC 12 Extents
- Detention Basin Present Extents
- Former Smith Creek Channel
- Underground Utility Lines/ Storm Water System

NJ Groundwater Criteria	
Lead	5

N

FIGURE: 7.20

November 2019
Groundwater Lead Map
Screened Interval: 0-20' BGS

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
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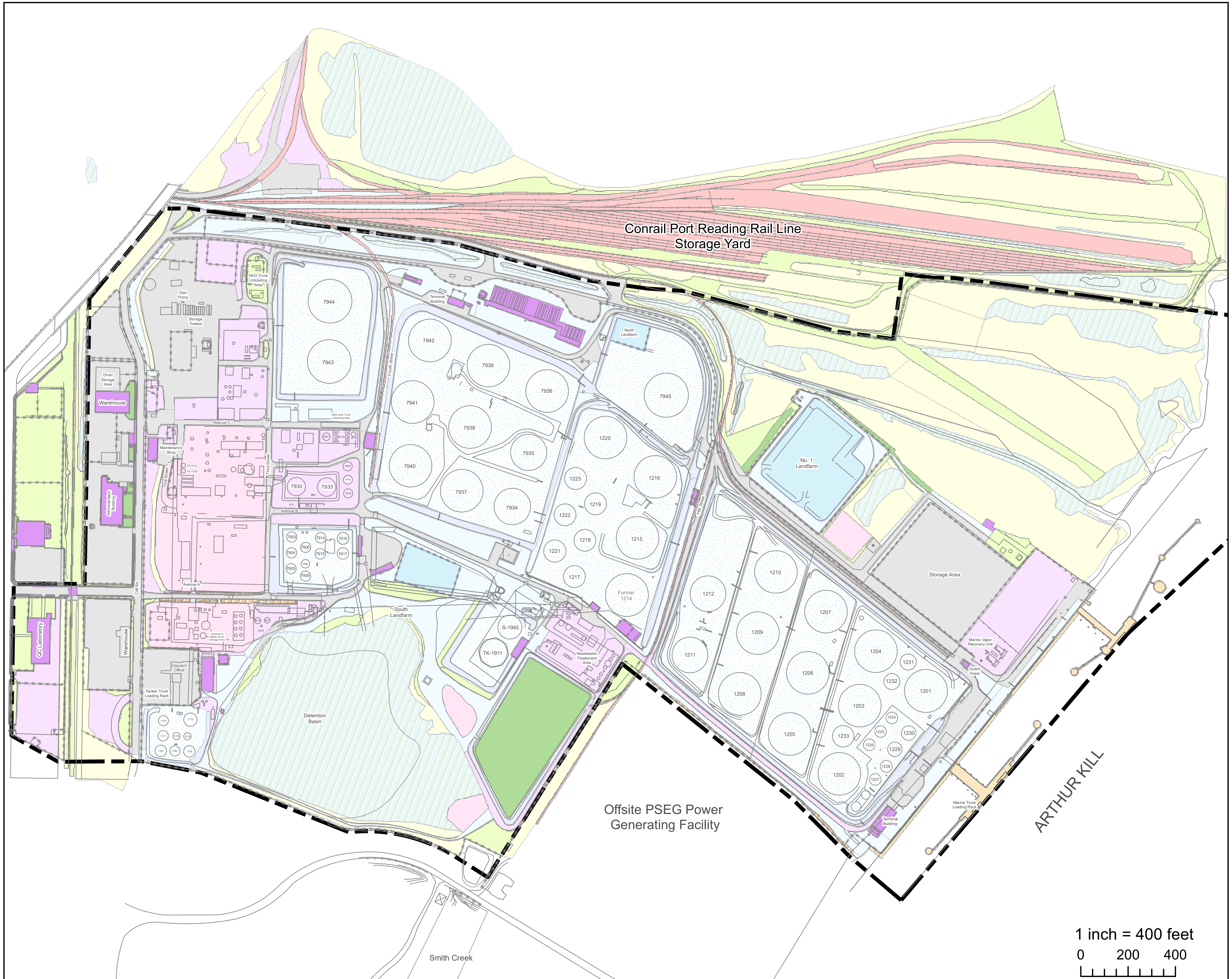

LEGEND

- Site Boundary
- Asphalt
- Gravel
- Vegetative Stone
- Degraded Asphalt or Millings
- Concrete Slabs
- Tankfield
- Exposed Soil
- Landscaping - grass areas
- Landfarm
- Wetlands
- Vegetative Uplands
- Ditch
- Berms
- Rail Roads
- Dock

N

FIGURE: 8
SITEWIDE SURFACE TYPE MAP

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	2/24/2021
SRP PI#:	006148	**Drawn By:**	KJ

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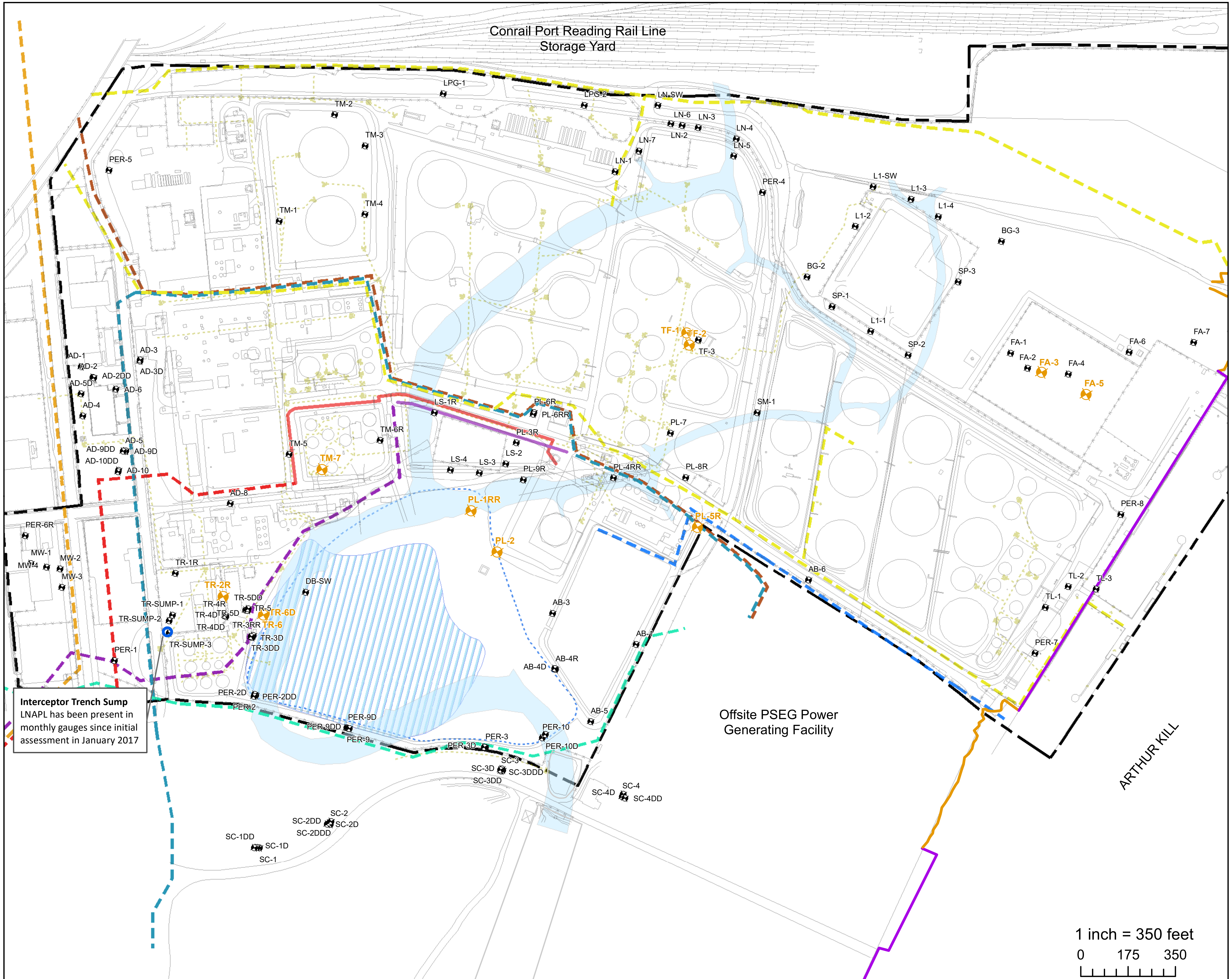
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451

This map was developed using New Jersey Department of Environmental Protection Geographic Information System Digital Data, but this secondary product has not been verified by NJDEP and is not state Authorized. Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.



LEGEND

- Monitoring Well - No Historic LNAPL Observations
- Monitoring Well - Sporatic Historic LNAPL Observations
- Former Smith Creek Channel
- Shoreline
- Bulkhead
- AOC 12 Extent
- Detention Basin Present Extents
- Site Boundary
- Underground Utility Lines

Pipelines

- 10" Embridge Natural Gas Pipeline
- 12" Spectra Pipeline
- 24" Outfall
- Buckeye Pipeline
- Buckeye Petroleum Pipeline - 608
- Buckeye Petroleum Pipeline - 609
- Colonial Pipeline
- Unknown Pipeline/ Utility
- Williams Pipeline

FIGURE: 9

PORT READING SITEWIDE HISTORIC LNAPL GAUGING

HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

Project #:	1114J01	**Drawn:**	02/24/2021
SRP PI#:	006148	**Drawn By:**	AE/RC

Earth Systems
Environmental Engineering
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451

1 inch = 350 feet
0 175 350

Document Path: P:\ArcGIS\HESS Projects\1114J00 - Port Reading Hess\1114J01 - Sitewide\GIS\Port Reading - Sitewide LNAPL.mxd

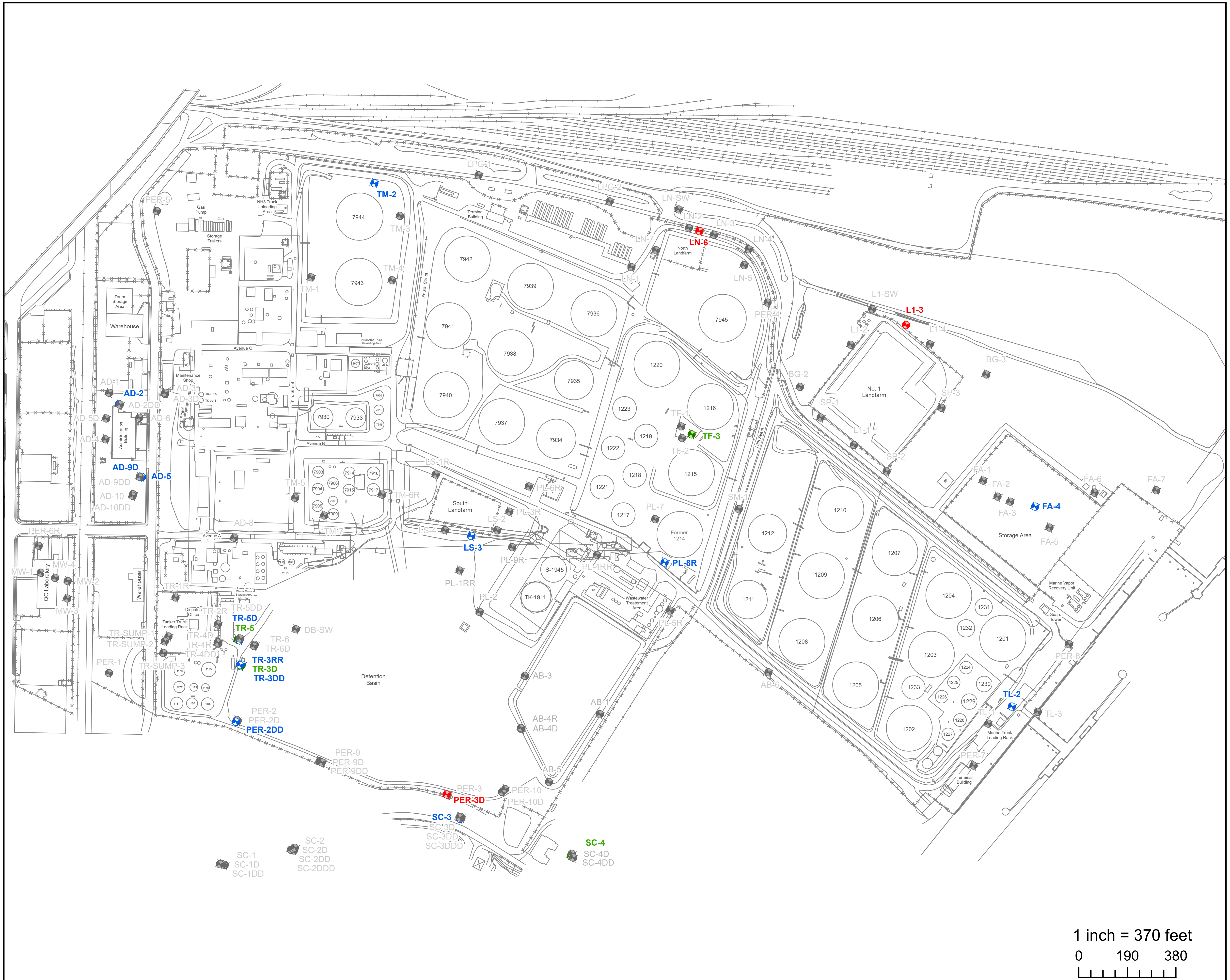
Attachment D

Tidal Study Package

Attachment D - Tidal Study Package
August 2020 Tidal Study Summary Table

Monitoring Well	Screen Depth Interval	Location of Site	Adjacent to Surface Waterbody?	Tidal Influence Status
AD-2	Shallow	Western Portion/AOC 11a: Admin. Building	No	Minor Tidal Influence
AD-5	Shallow	Western Portion/AOC 11a: Admin. Building	No	Minor Tidal Influence
AD-9D	Intermediate	Western Portion/AOC 11a: Admin. Building	No	Minor Tidal Influence
FA-4	Shallow	Northeast Portion/AOC 103: Fire Pits	Yes, Arthur Kill	Minor Tidal Influence
L1-3	Shallow	Northern Boundary/AOC 3: No. 1 Landfarm	Yes, North Drainage Ditch	Significant Tidal Influence
LN-6	Shallow	Northern Boundary/AOC 1: North Landfarm	Yes, North Drainage Ditch	Significant Tidal Influence
LS-3	Shallow	Central Portion/AOC 2: South Landfarm	Yes, Detention Basin	Minor Tidal Influence
PER-2DD	Deep	Southwest Portion/AOC 12: Detention Basin	Yes, Detention Basin	Minor Tidal Influence
PER-3D	Intermediate	Southwest Portion/AOC 10: Truck Loading Rack	Yes, Detention Basin	Significant Tidal Influence
PL-8R	Shallow	Central Portion/AOC 54: Third Tankfield	No	Minor Tidal Influence
SC-3	Shallow	Southwest Portion/AOC 12: Detention Basin	Yes, Detention Basin	Minor Tidal Influence
SC-4	Shallow	Southwest Portion/AOC 12: Smith Creek	Yes, Smith Creek	No Tidal Influence
TF-3	Shallow	Central Portion/AOC 54: Third Tankfield	No	No Tidal Influence
TL-2	Shallow	Eastern Portion/AOC 105: South Dock	Yes, Arthur Kill	Minor Tidal Influence
TM-2	Shallow	Northwestern Portion/AOC 14a: First Tankfield	No	Minor Tidal Influence
TR-3D	Intermediate	Southwest Portion/AOC 10: Truck Loading Rack	Yes, Detention Basin	No Tidal Influence
TR-3DD	Deep	Southwest Portion/AOC 10: Truck Loading Rack	Yes, Detention Basin	Minor Tidal Influence
TR-3RR	Shallow	Southwest Portion/AOC 10: Truck Loading Rack	Yes, Detention Basin	Minor Tidal Influence
TR-5	Shallow	Southwest Portion/AOC 10: Truck Loading Rack	Yes, Detention Basin	No Tidal Influence
TR-5D	Intermediate	Southwest Portion/AOC 10: Truck Loading Rack	Yes, Detention Basin	Minor Tidal Influence

Table Notes:
Shallow = Approximately 0-20 feet below ground surface (bgs)
Intermediate = Approximately 15-30 feet bgs
Deep = Approximately 50-60 feet bgs



LEGEND

- No Study Conducted
- No Tidal Influence
- Minor Tidal Influence
- Significant Tidal Influence

August 2020 Tidal Study Map

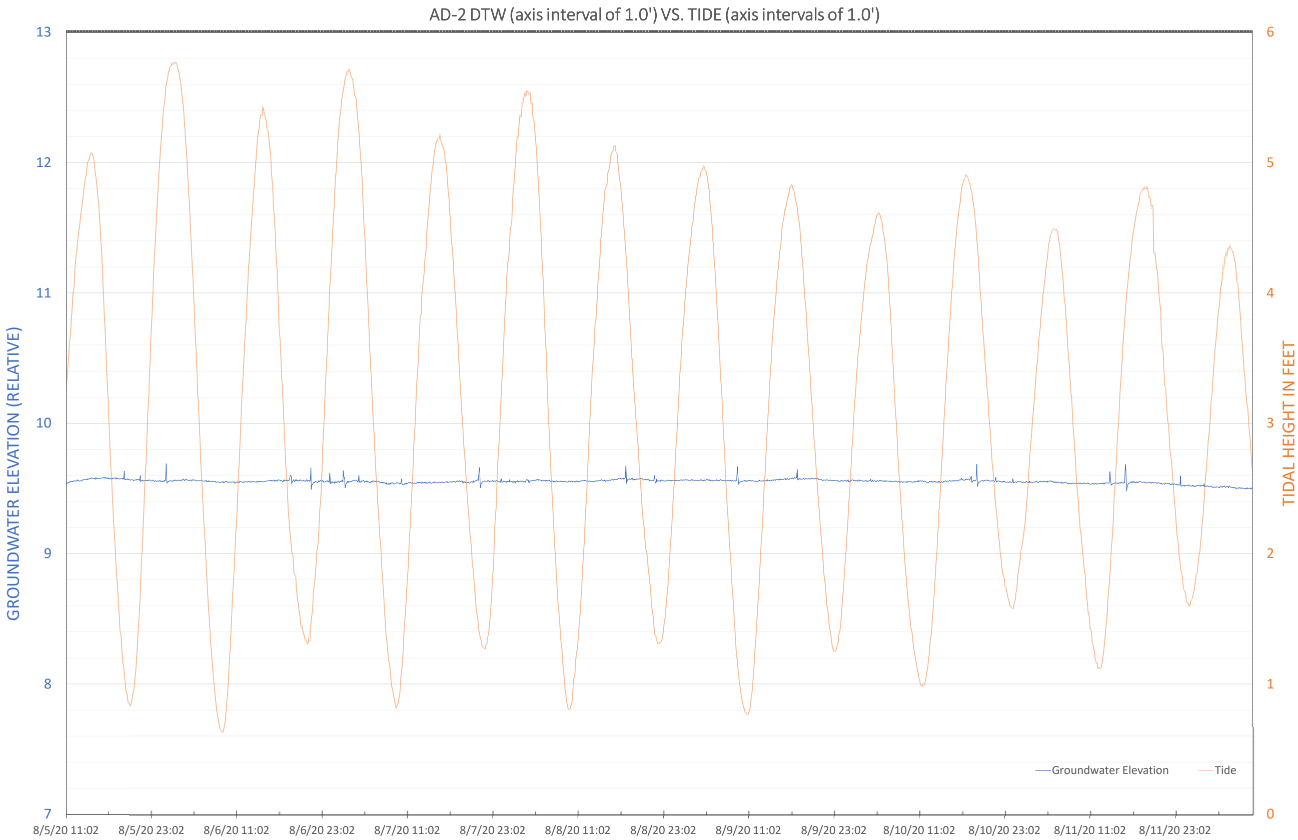
HESS CORPORATION
FORMER PORT READING COMPLEX
750 CLIFF ROAD
PORT READING, NEW JERSEY

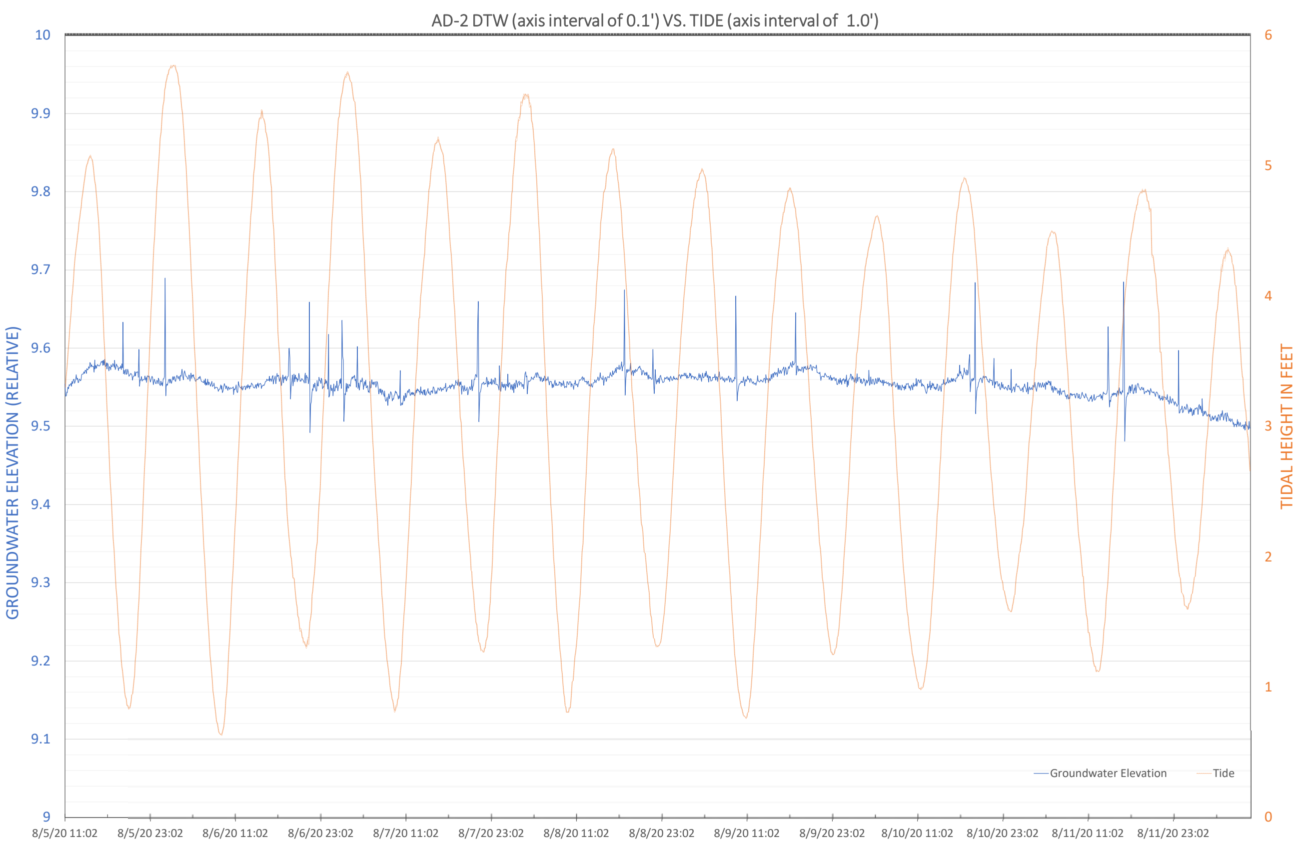
Project #:	1114J01	**Drawn:**	8/25/2020
SRP PI#:	006148	**Drawn By:**	AE

Earth Systems
Environmental Engineering
1625 Highway 71, Belmar, NJ 07719
T. 732.739.6444 | F. 732.739.0451

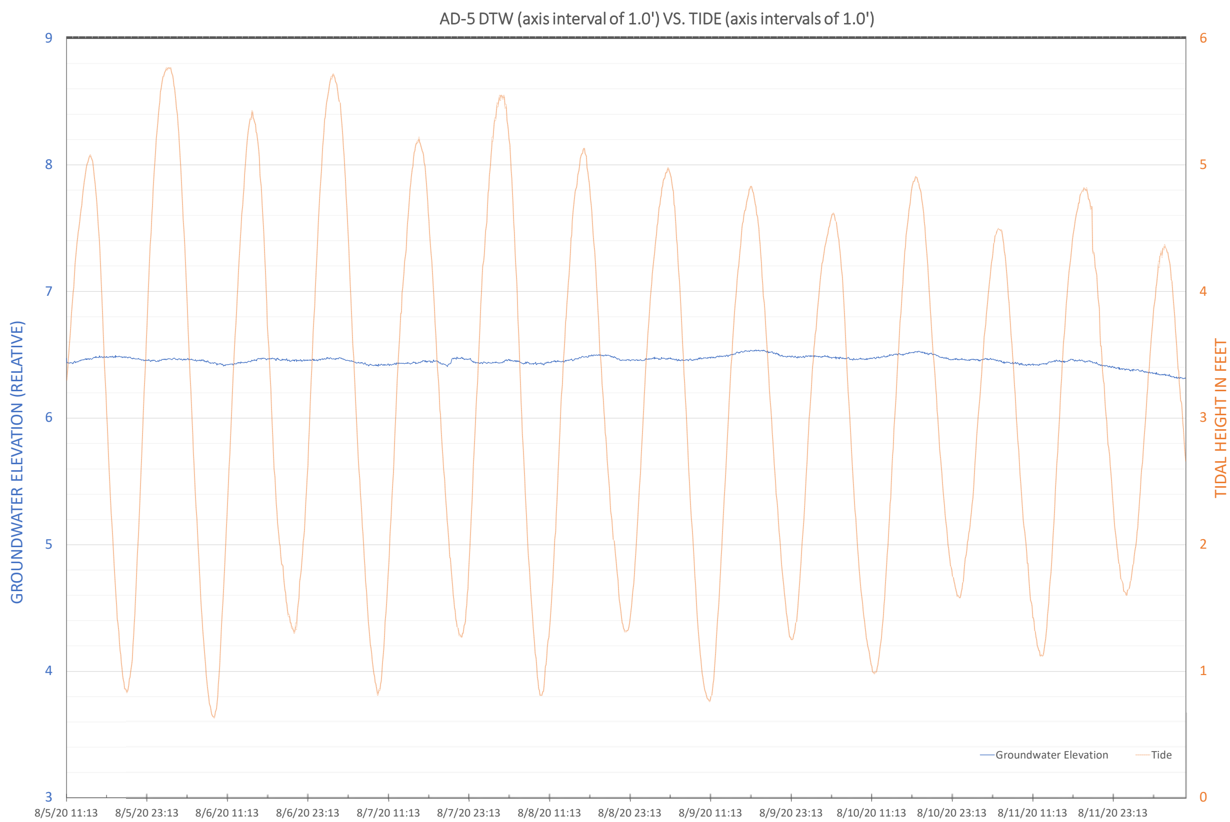
This map was developed using New Jersey Department of Environmental Protection Geographic Information System Digital Data, but this secondary product has not been verified by NJDEP and is not state Authorized. Source: NAD 1983 (2011) New Jersey State Plane FIPS 2900 US FT.

AD-2

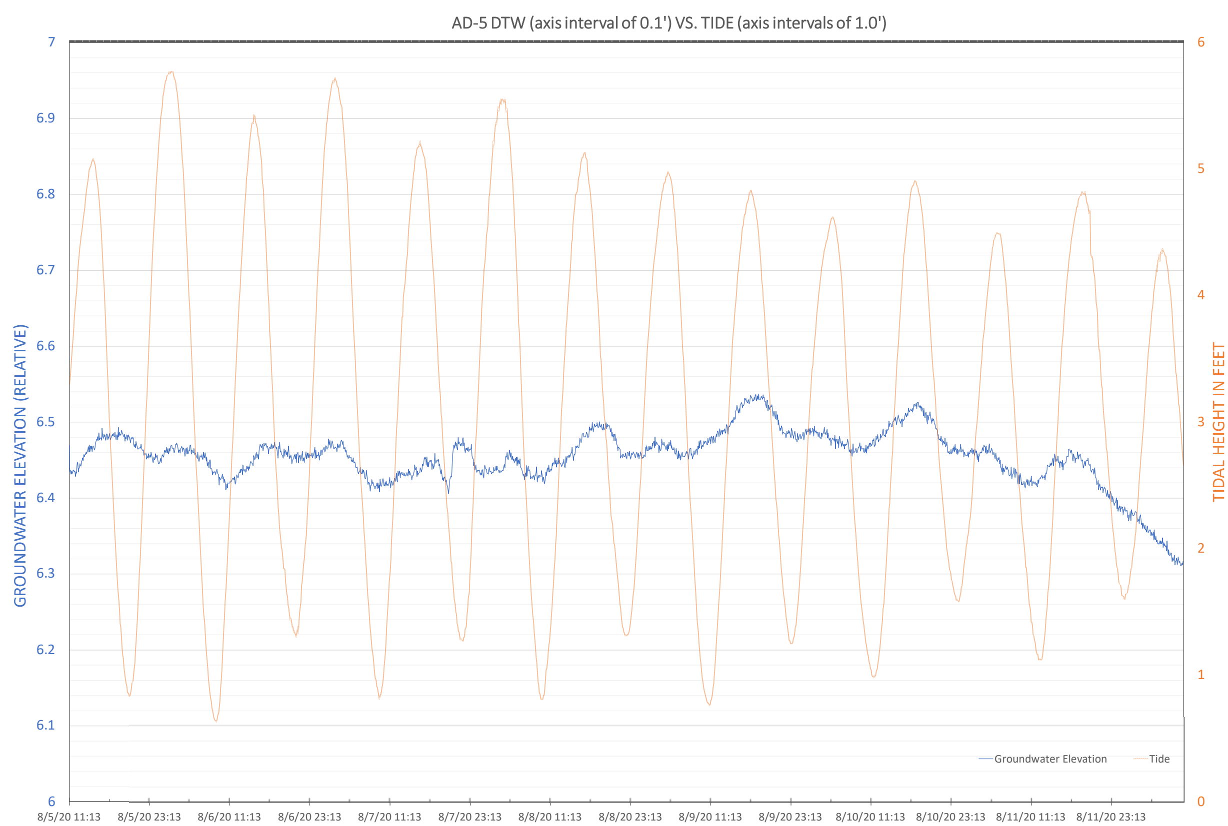

AD-2 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 11:02
8/5/20 23:02
8/6/20 11:02
8/6/20 23:02
8/7/20 11:02
8/7/20 23:02
8/8/20 11:02
8/8/20 23:02
8/9/20 11:02
8/9/20 23:02
8/10/20 11:02
8/10/20 23:02
8/11/20 11:02
8/11/20 23:02


AD-2 DTW (axis interval of 0.1') VS. TIDE (axis interval of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
10
9.9
9.8
9.7
9.6
9.5
9.4
9.3
9.2
9.1
9
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 11:02
8/5/20 23:02
8/6/20 11:02
8/6/20 23:02
8/7/20 11:02
8/7/20 23:02
8/8/20 11:02
8/8/20 23:02
8/9/20 11:02
8/9/20 23:02
8/10/20 11:02
8/10/20 23:02
8/11/20 11:02
8/11/20 23:02

AD-5

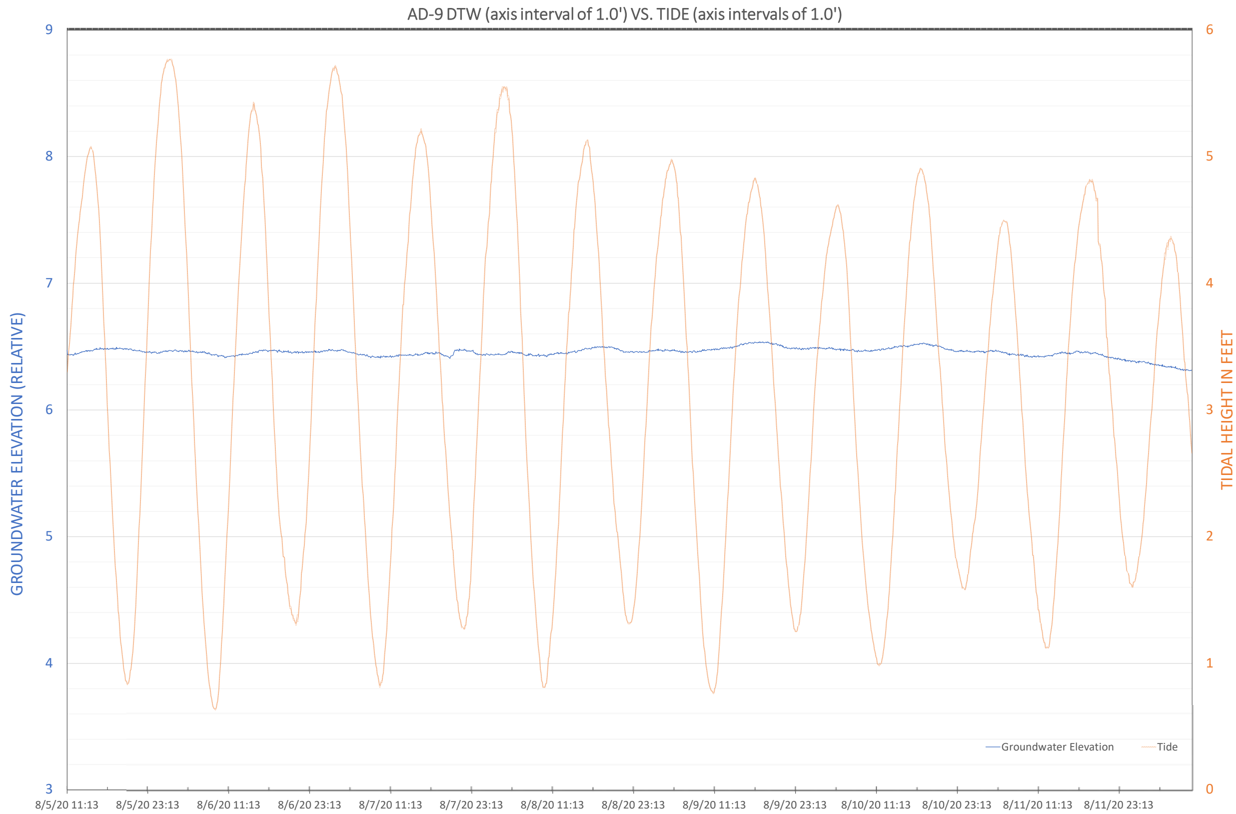


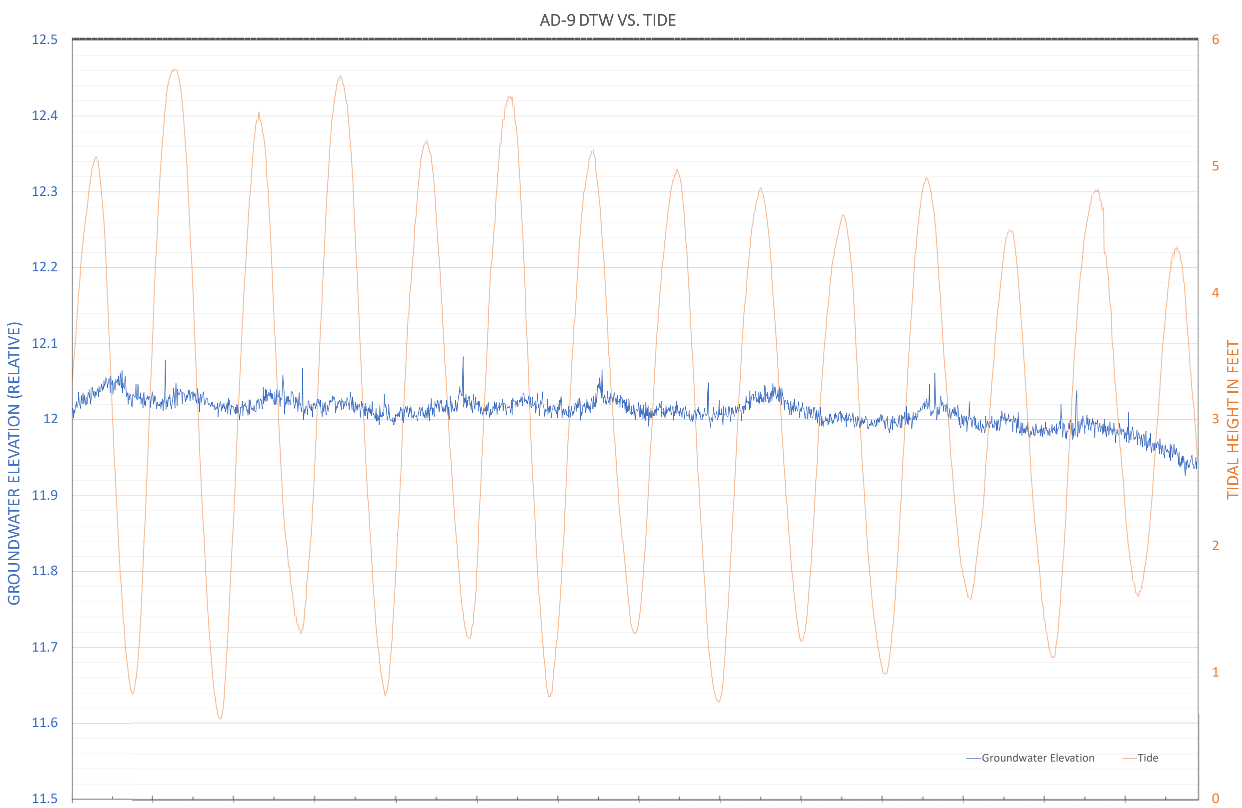
AD-5 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
9
8
7
6
5
4
3
6
5
4
3
2
1
0
8/5/20 11:13
8/5/20 23:13
8/6/20 11:13
8/6/20 23:13
8/7/20 11:13
8/7/20 23:13
8/8/20 11:13
8/8/20 23:13
8/9/20 11:13
8/9/20 23:13
8/10/20 11:13
8/10/20 23:13
8/11/20 11:13
8/11/20 23:13
Groundwater Elevation
Tide



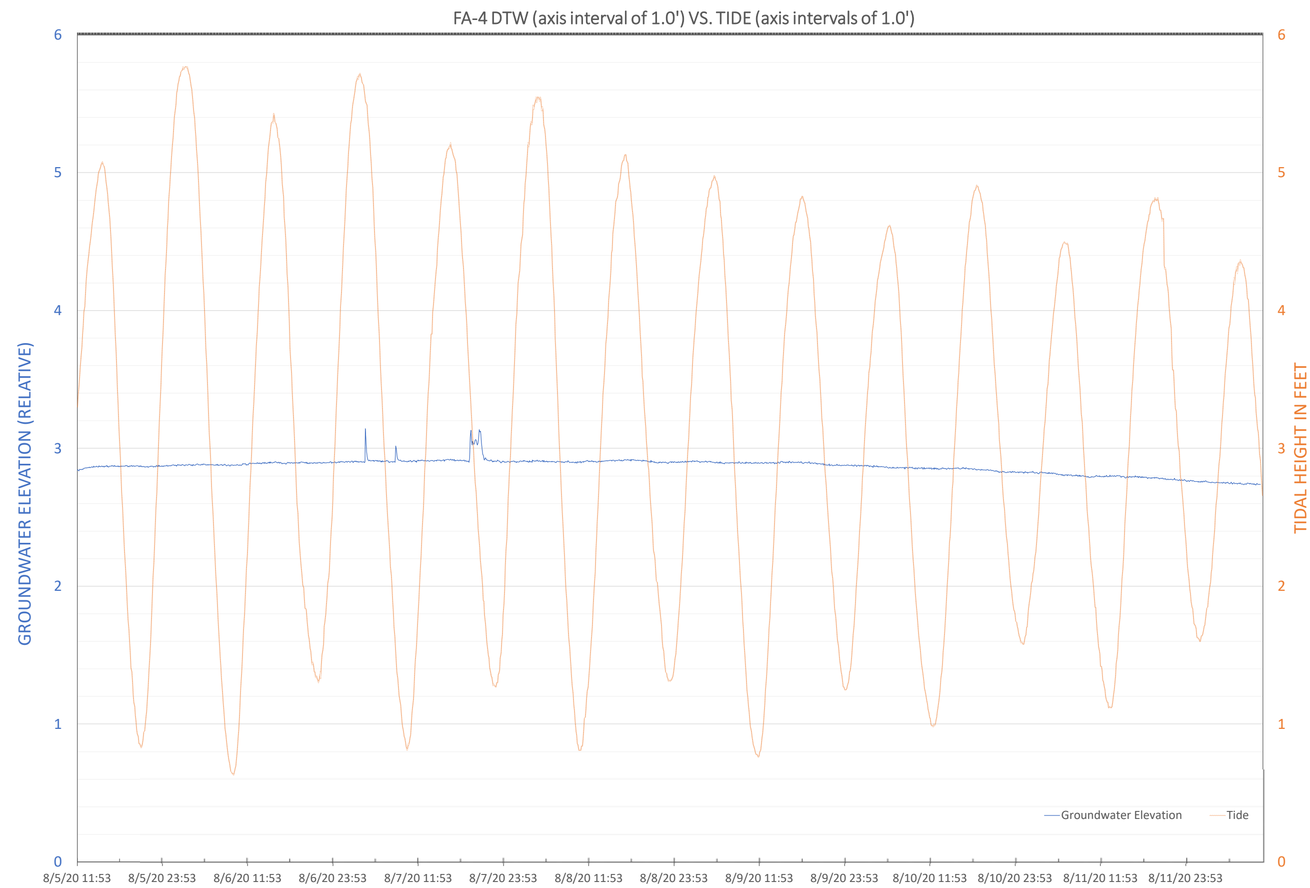
AD-5 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
6
5
4
3
2
1
0
8/5/20 11:13
8/5/20 23:13
8/6/20 11:13
8/6/20 23:13
8/7/20 11:13
8/7/20 23:13
8/8/20 11:13
8/8/20 23:13
8/9/20 11:13
8/9/20 23:13
8/10/20 11:13
8/10/20 23:13
8/11/20 11:13
8/11/20 23:13
Groundwater Elevation
Tide

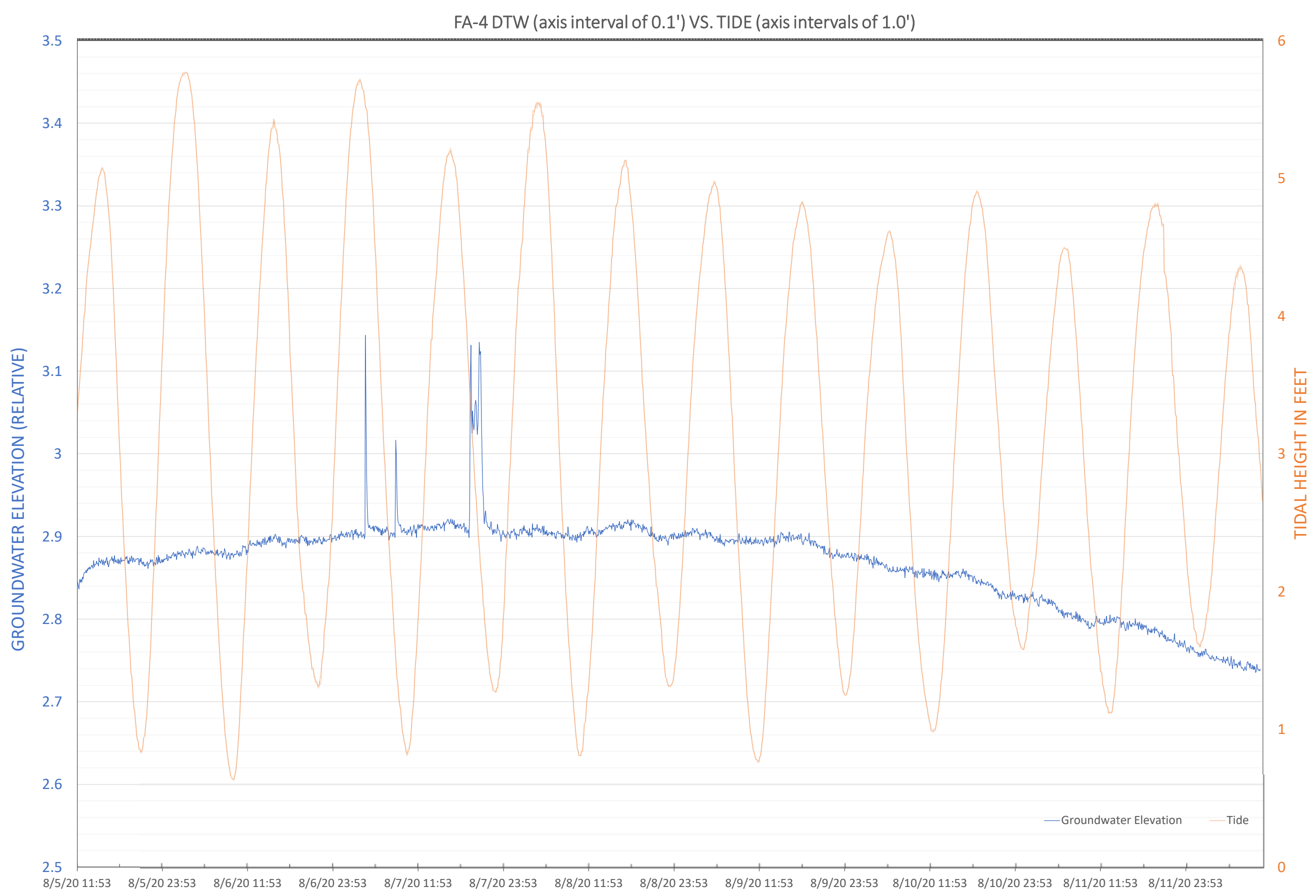
AD-9


AD-9 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
9
8
7
6
5
4
3
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 11:13
8/5/20 23:13
8/6/20 11:13
8/6/20 23:13
8/7/20 11:13
8/7/20 23:13
8/8/20 11:13
8/8/20 23:13
8/9/20 11:13
8/9/20 23:13
8/10/20 11:13
8/10/20 23:13
8/11/20 11:13
8/11/20 23:13

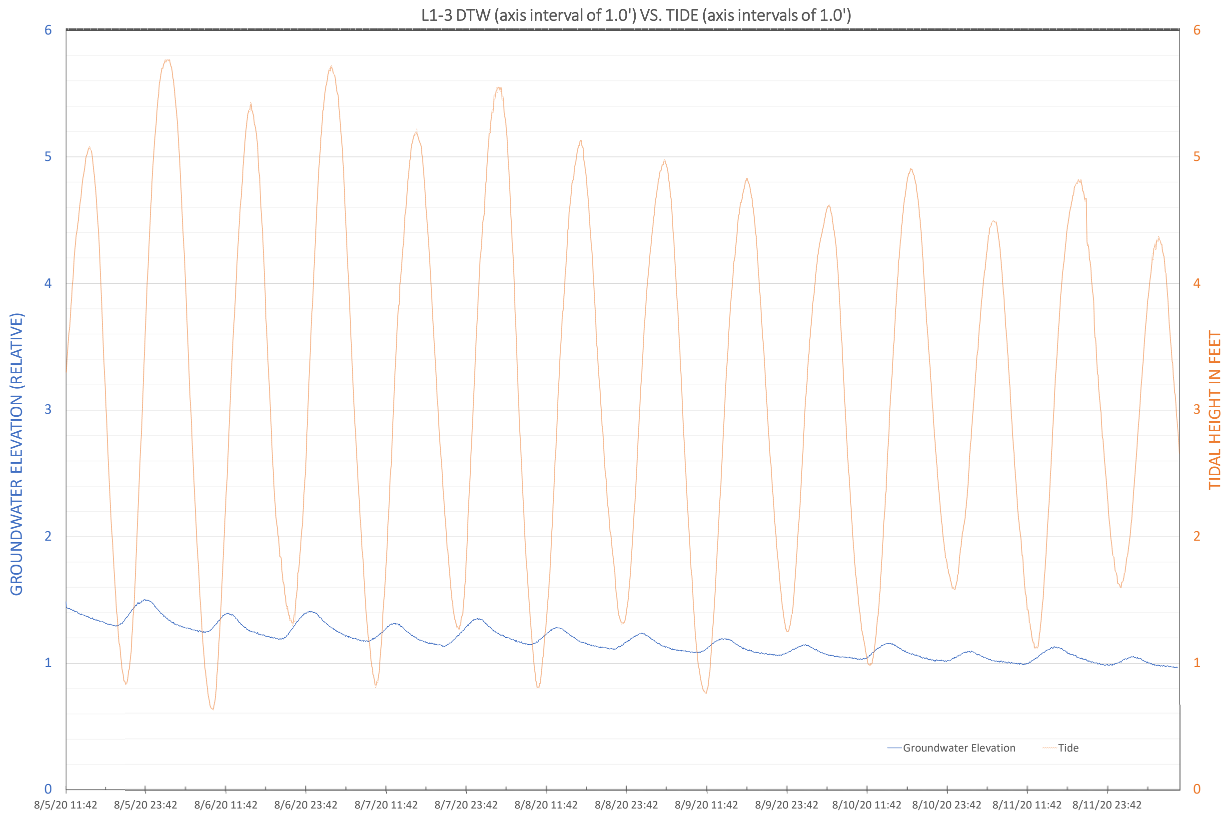

AD-9 DTW VS. TIDE
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
12.5
12.4
12.3
12.2
12.1
12
11.9
11.8
11.7
11.6
11.5
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 11:18
8/5/20 23:18
8/6/20 11:18
8/6/20 23:18
8/7/20 11:18
8/7/20 23:18
8/8/20 11:18
8/8/20 23:18
8/9/20 11:18
8/9/20 23:18
8/10/20 11:18
8/10/20 23:18
8/11/20 11:18
8/11/20 23:18

FA-4

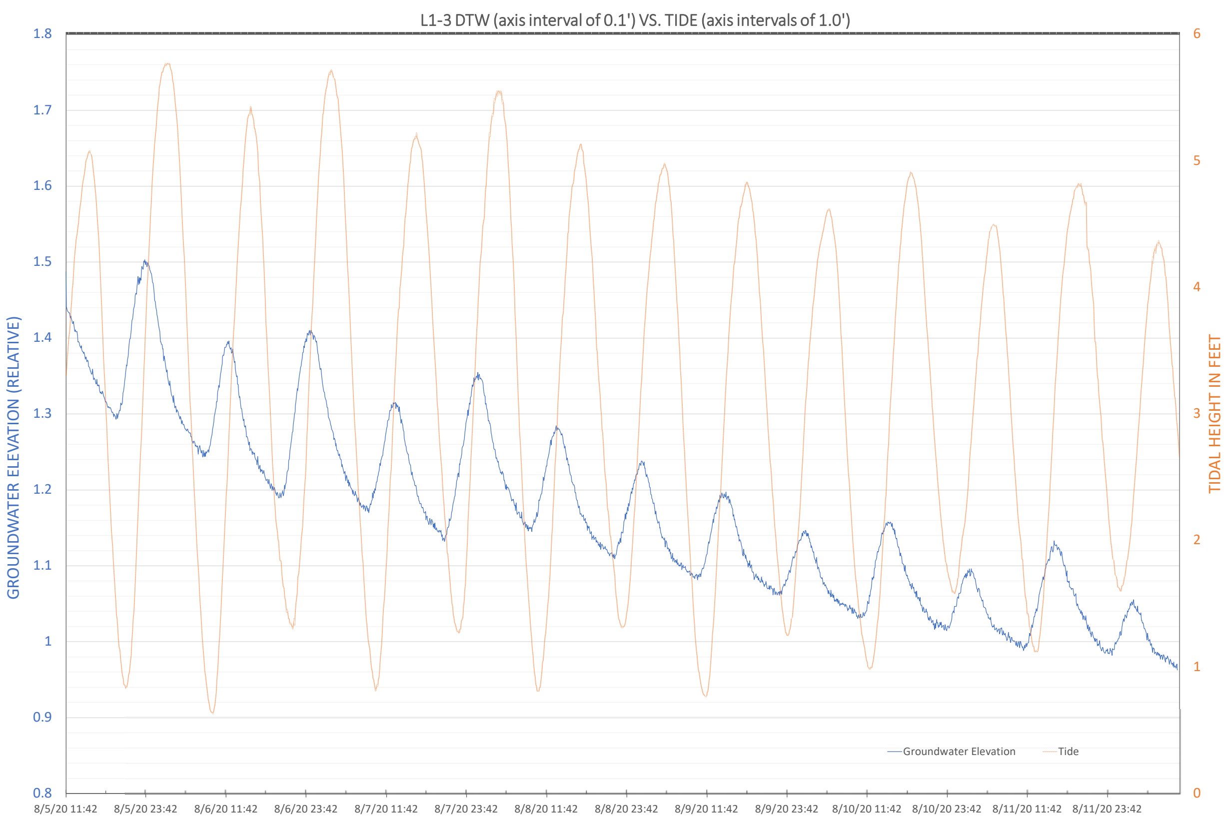

FA-4 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
0
1
2
3
4
5
6
8/5/20 11:53
8/5/20 23:53
8/6/20 11:53
8/6/20 23:53
8/7/20 11:53
8/7/20 23:53
8/8/20 11:53
8/8/20 23:53
8/9/20 11:53
8/9/20 23:53
8/10/20 11:53
8/10/20 23:53
8/11/20 11:53
8/11/20 23:53
Groundwater Elevation
Tide


FA-4 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
2.5
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
3.4
3.5
0
1
2
3
4
5
6
8/5/20 11:53
8/5/20 23:53
8/6/20 11:53
8/6/20 23:53
8/7/20 11:53
8/7/20 23:53
8/8/20 11:53
8/8/20 23:53
8/9/20 11:53
8/9/20 23:53
8/10/20 11:53
8/10/20 23:53
8/11/20 11:53
8/11/20 23:53
Groundwater Elevation
Tide

L1-3

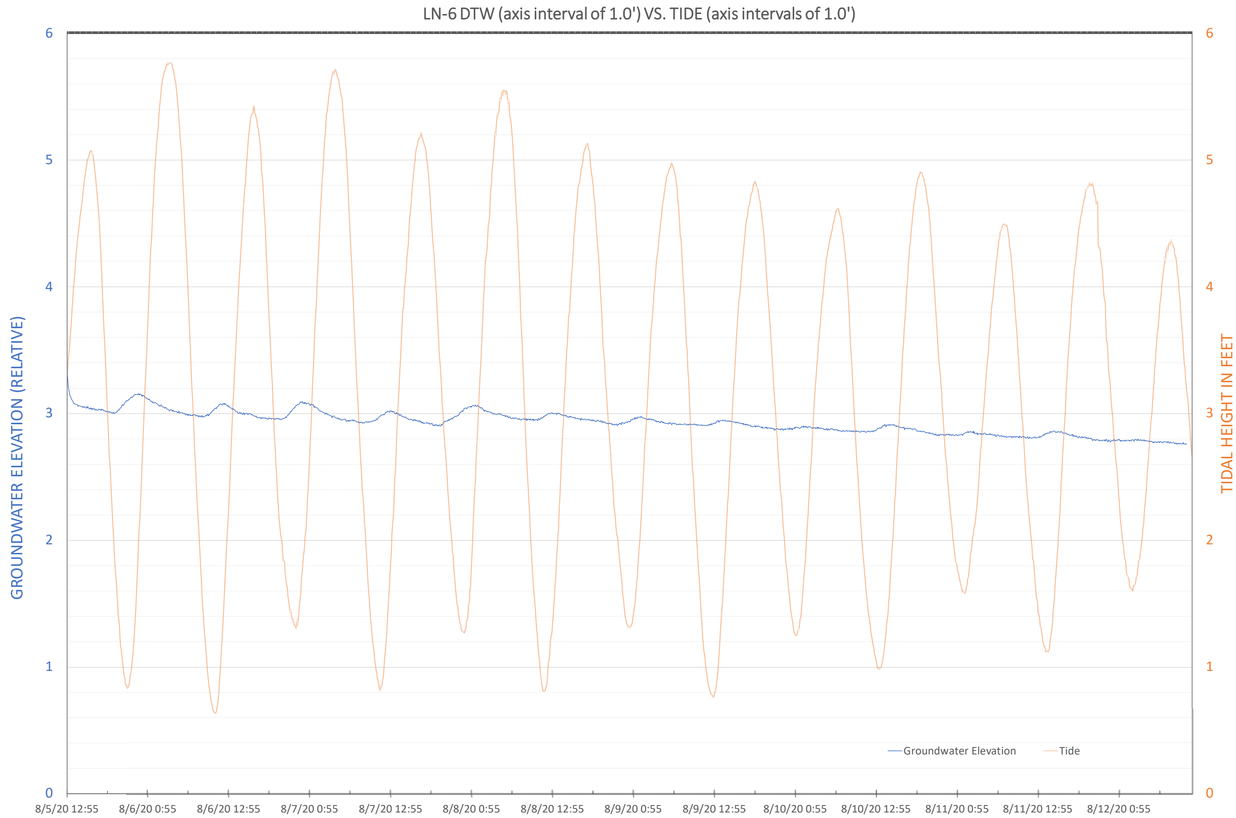


L1-3 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
0
1
2
3
4
5
6
8/5/20 11:42
8/5/20 23:42
8/6/20 11:42
8/6/20 23:42
8/7/20 11:42
8/7/20 23:42
8/8/20 11:42
8/8/20 23:42
8/9/20 11:42
8/9/20 23:42
8/10/20 11:42
8/10/20 23:42
8/11/20 11:42
8/11/20 23:42
Groundwater Elevation
Tide

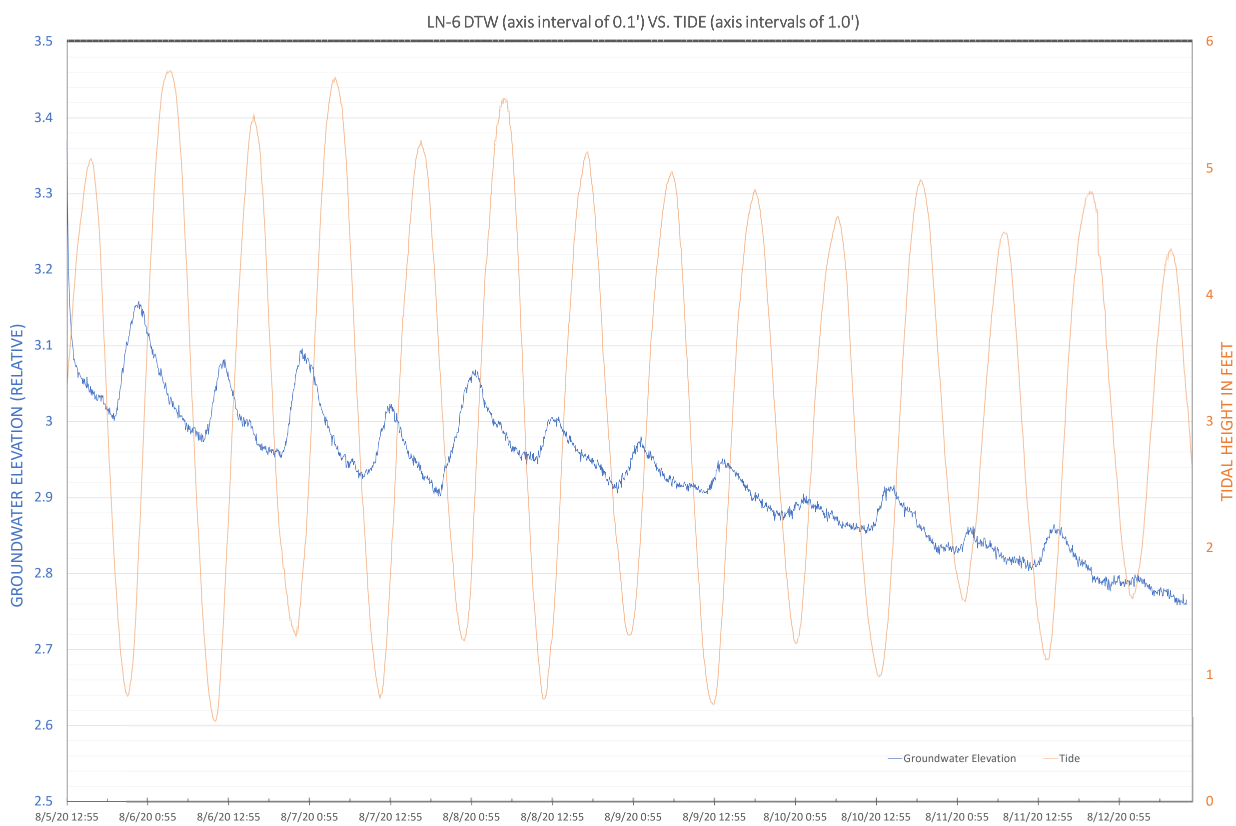


L1-3 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
0
1
2
3
4
5
6
8/5/20 11:42
8/5/20 23:42
8/6/20 11:42
8/6/20 23:42
8/7/20 11:42
8/7/20 23:42
8/8/20 11:42
8/8/20 23:42
8/9/20 11:42
8/9/20 23:42
8/10/20 11:42
8/10/20 23:42
8/11/20 11:42
8/11/20 23:42
Groundwater Elevation
Tide

LN-6

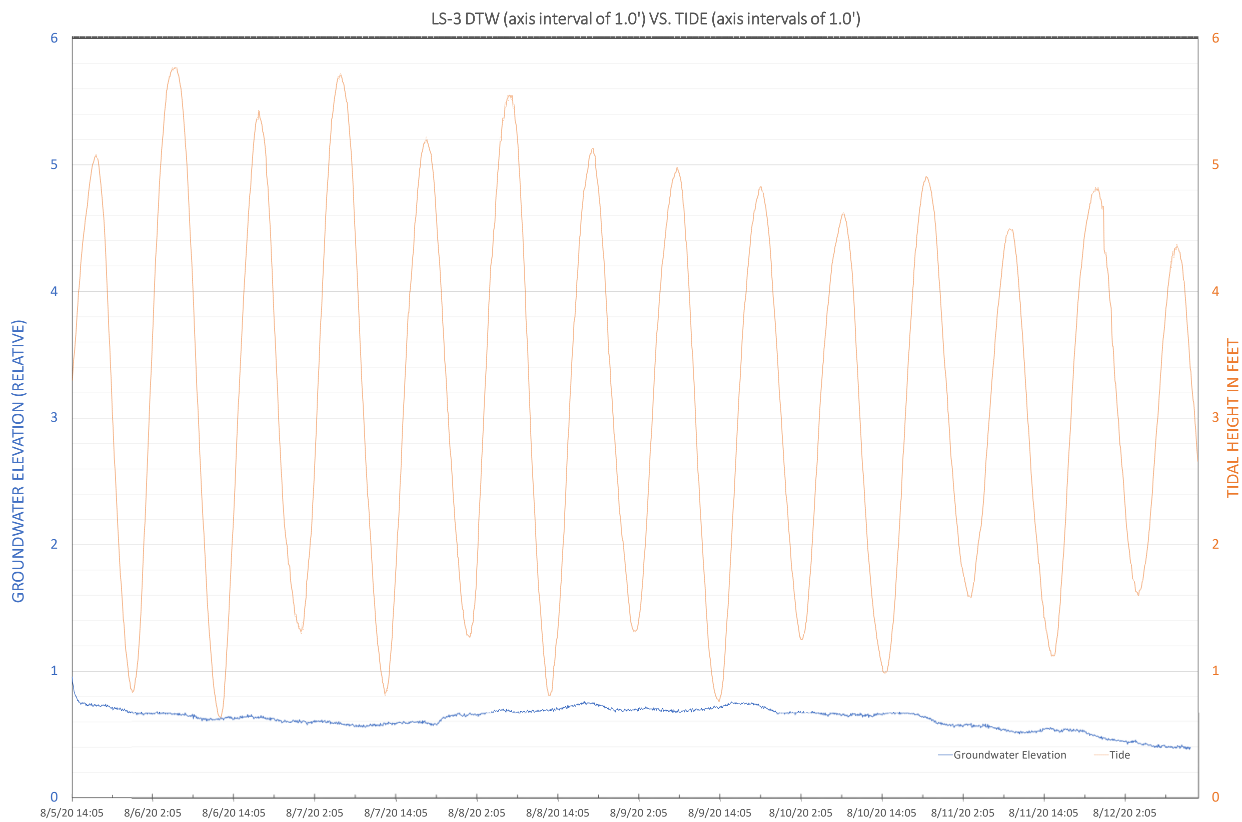


LN-6 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
0
1
2
3
4
5
6
8/5/20 12:55
8/6/20 0:55
8/6/20 12:55
8/7/20 0:55
8/7/20 12:55
8/8/20 0:55
8/8/20 12:55
8/9/20 0:55
8/9/20 12:55
8/10/20 0:55
8/10/20 12:55
8/11/20 0:55
8/11/20 12:55
8/12/20 0:55
Groundwater Elevation
Tide

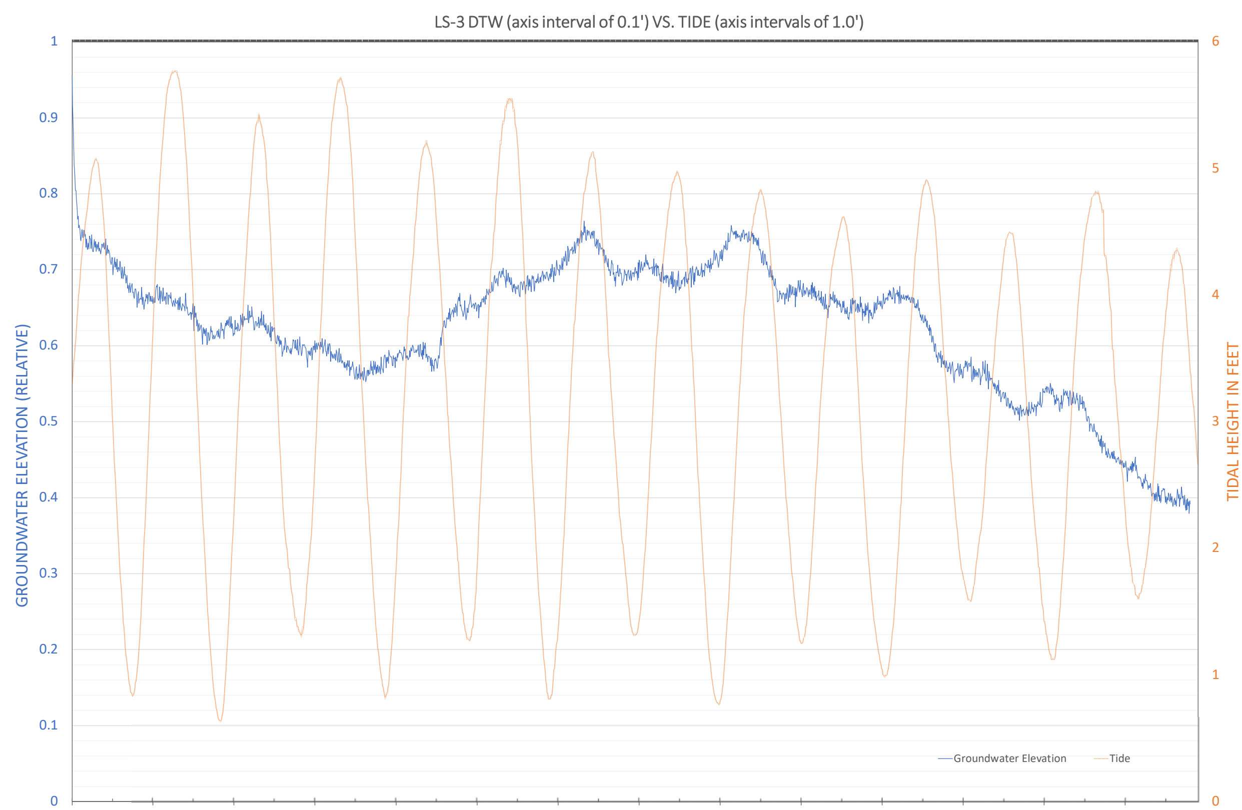


LN-6 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
2.5
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
3.4
3.5
0
1
2
3
4
5
6
8/5/20 12:55
8/6/20 0:55
8/6/20 12:55
8/7/20 0:55
8/7/20 12:55
8/8/20 0:55
8/8/20 12:55
8/9/20 0:55
8/9/20 12:55
8/10/20 0:55
8/10/20 12:55
8/11/20 0:55
8/11/20 12:55
8/12/20 0:55
Groundwater Elevation
Tide

LS-3

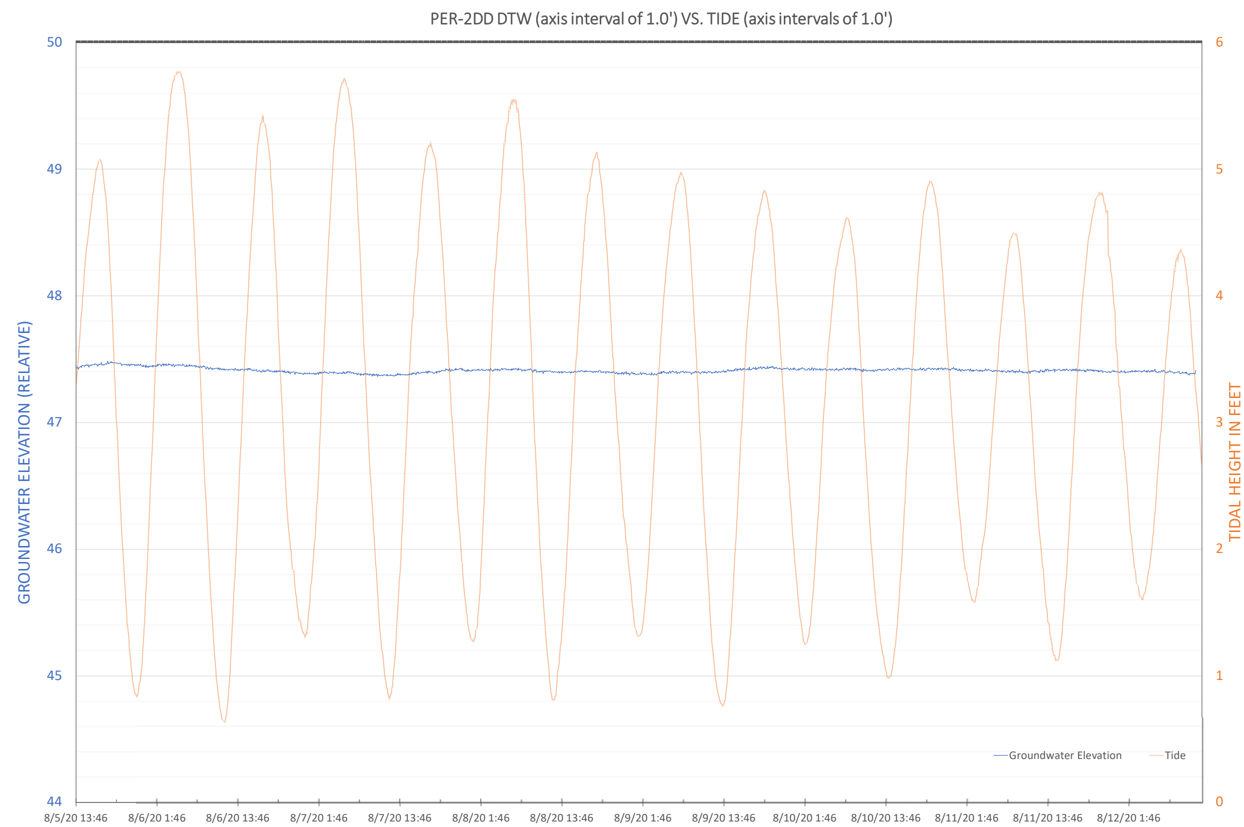


LS-3 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
0
1
2
3
4
5
6
8/5/20 14:05
8/6/20 2:05
8/6/20 14:05
8/7/20 2:05
8/7/20 14:05
8/8/20 2:05
8/8/20 14:05
8/9/20 2:05
8/9/20 14:05
8/10/20 2:05
8/10/20 14:05
8/11/20 2:05
8/11/20 14:05
8/12/20 2:05
Groundwater Elevation
Tide



LS-3 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
1
2
3
4
5
6
8/5/20 14:05
8/6/20 2:05
8/6/20 14:05
8/7/20 2:05
8/7/20 14:05
8/8/20 2:05
8/8/20 14:05
8/9/20 2:05
8/9/20 14:05
8/10/20 2:05
8/10/20 14:05
8/11/20 2:05
8/11/20 14:05
8/12/20 2:05
Groundwater Elevation
Tide

PER-2DD


PER-2DD DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
8/5/20 13:46
8/6/20 1:46
8/6/20 13:46
8/7/20 1:46
8/7/20 13:46
8/8/20 1:46
8/8/20 13:46
8/9/20 1:46
8/9/20 13:46
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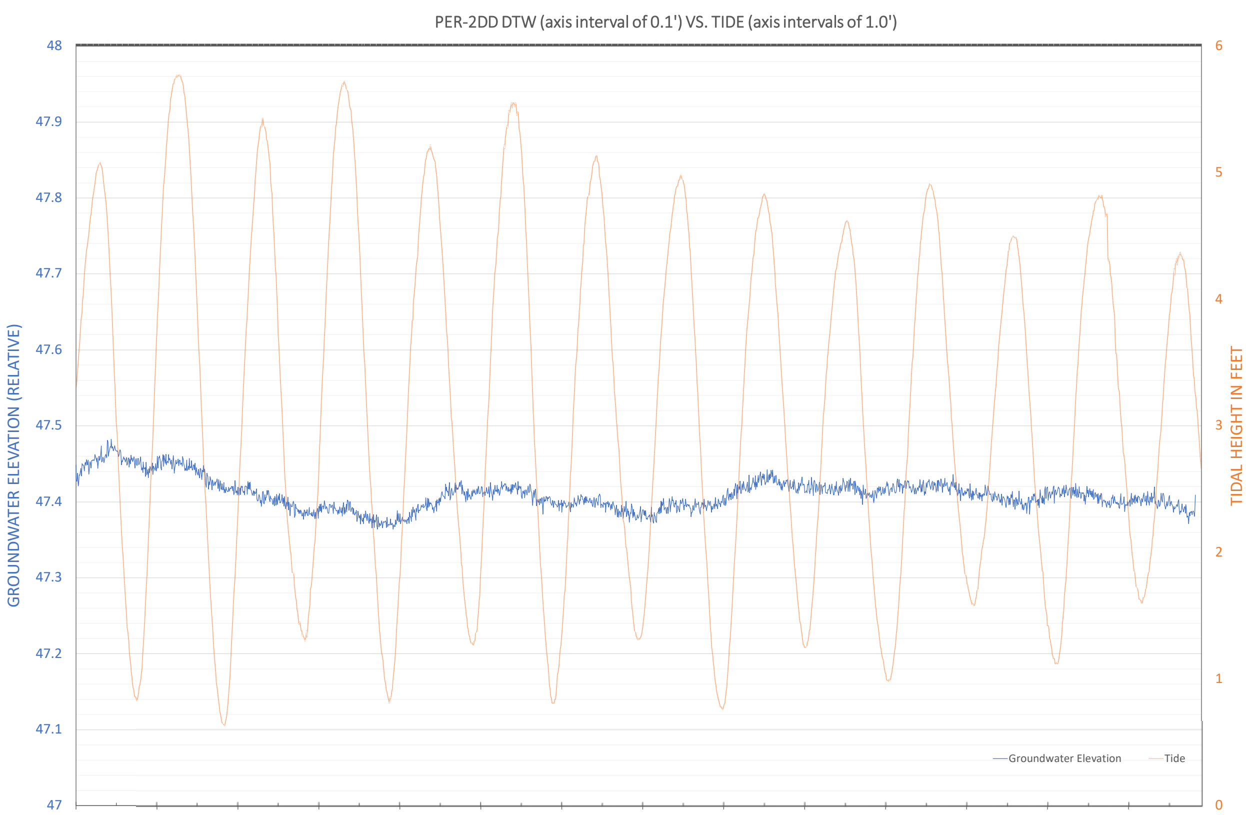
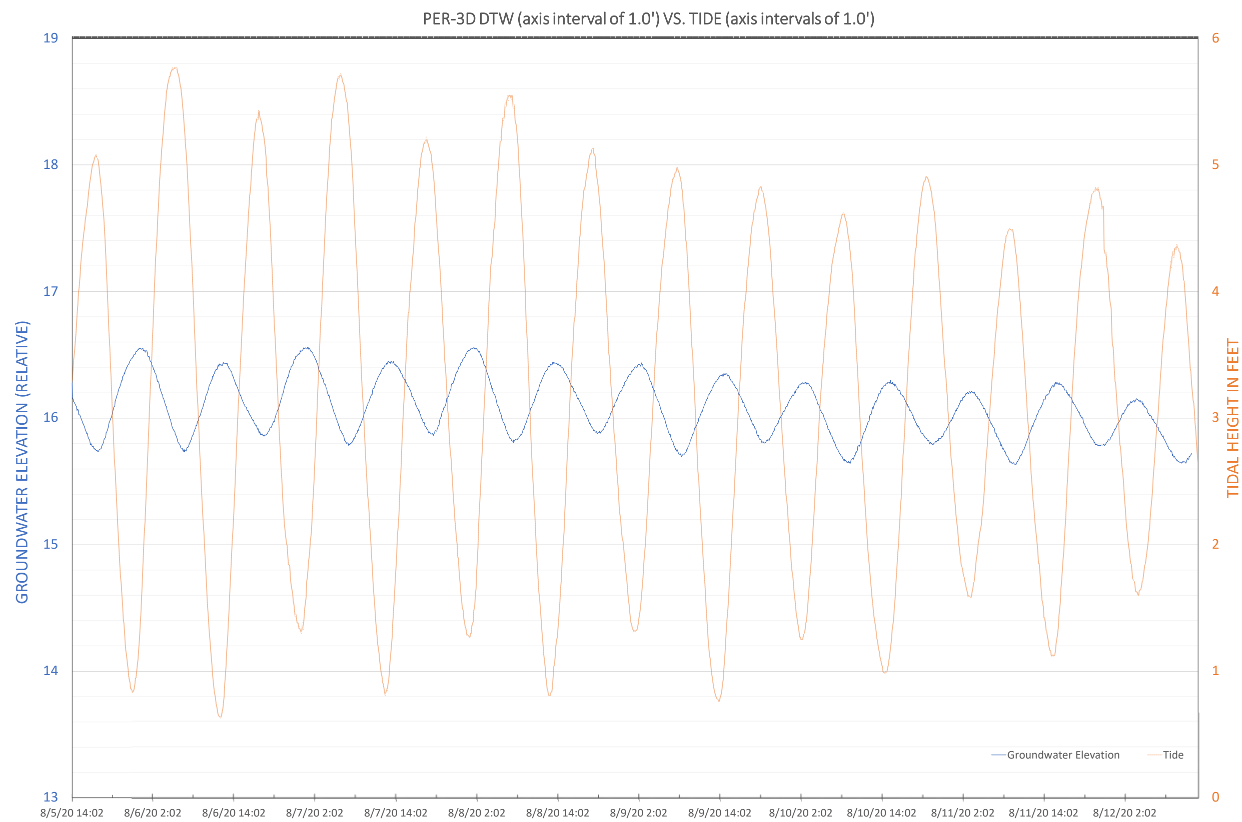
8/11/20 1:46
8/11/20 13:46
8/12/20 1:46


PER-2DD DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
8/5/20 13:46
8/6/20 1:46
8/6/20 13:46
8/7/20 1:46
8/7/20 13:46
8/8/20 1:46
8/8/20 13:46
8/9/20 1:46
8/9/20 13:46
8/10/20 1:46
8/10/20 13:46
8/11/20 1:46
8/11/20 13:46
8/12/20 1:46

PER-3D



PER-3D DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
19
18
17
16
15
14
13
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 14:02
8/6/20 2:02
8/6/20 14:02
8/7/20 2:02
8/7/20 14:02
8/8/20 2:02
8/8/20 14:02
8/9/20 2:02
8/9/20 14:02
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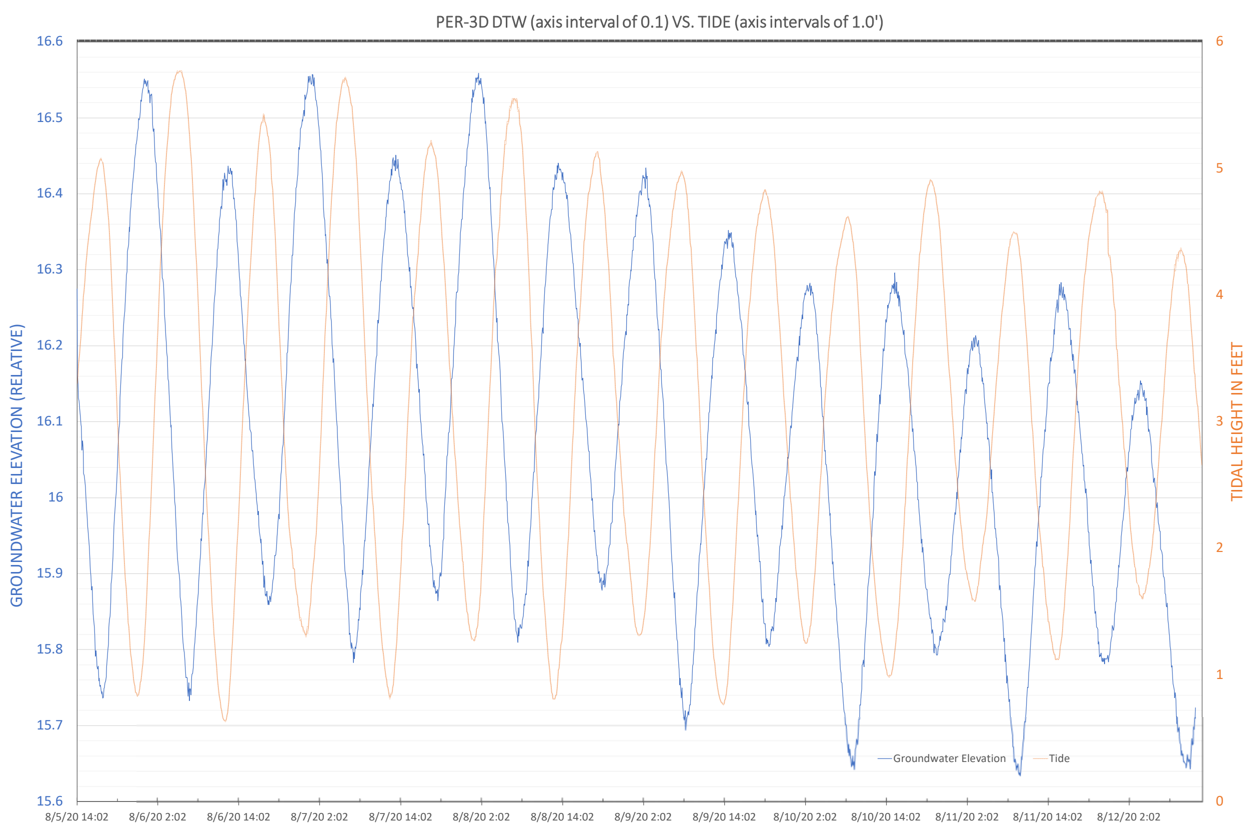
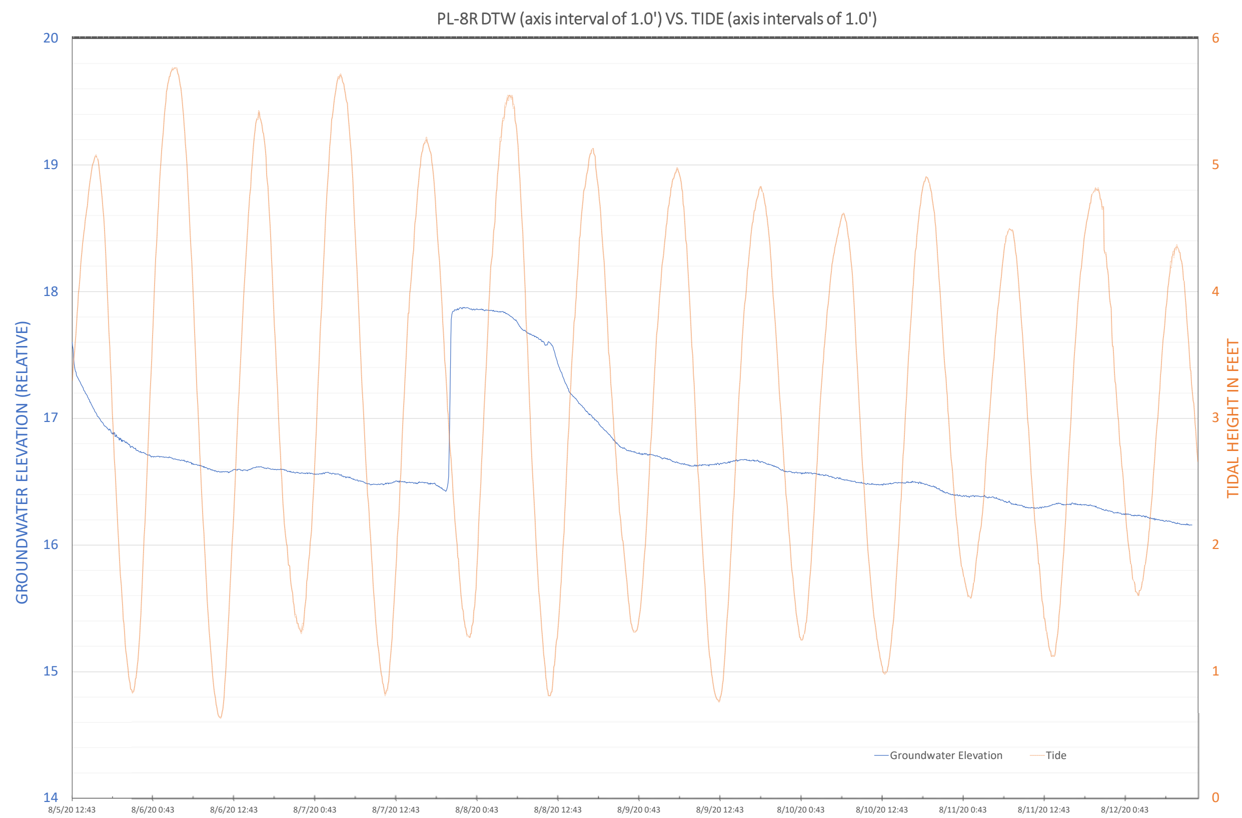
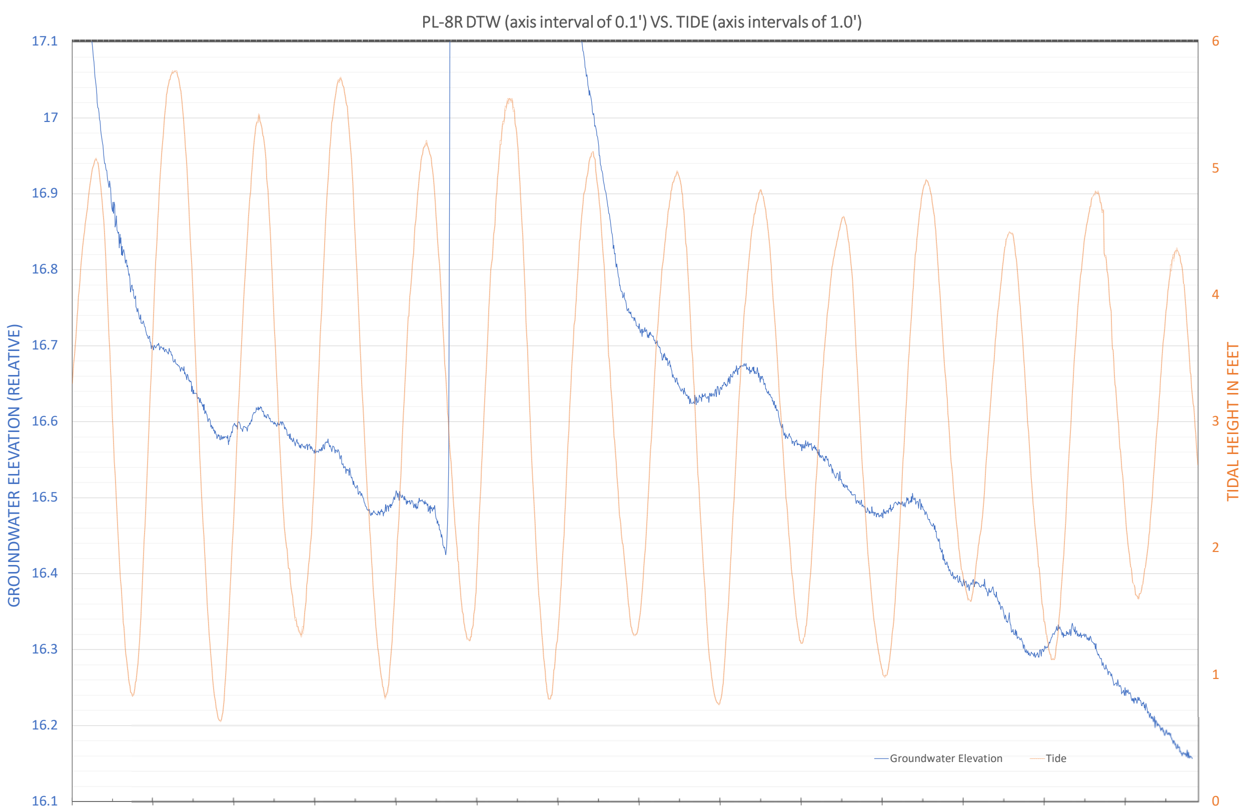
8/11/20 14:02
8/12/20 2:02



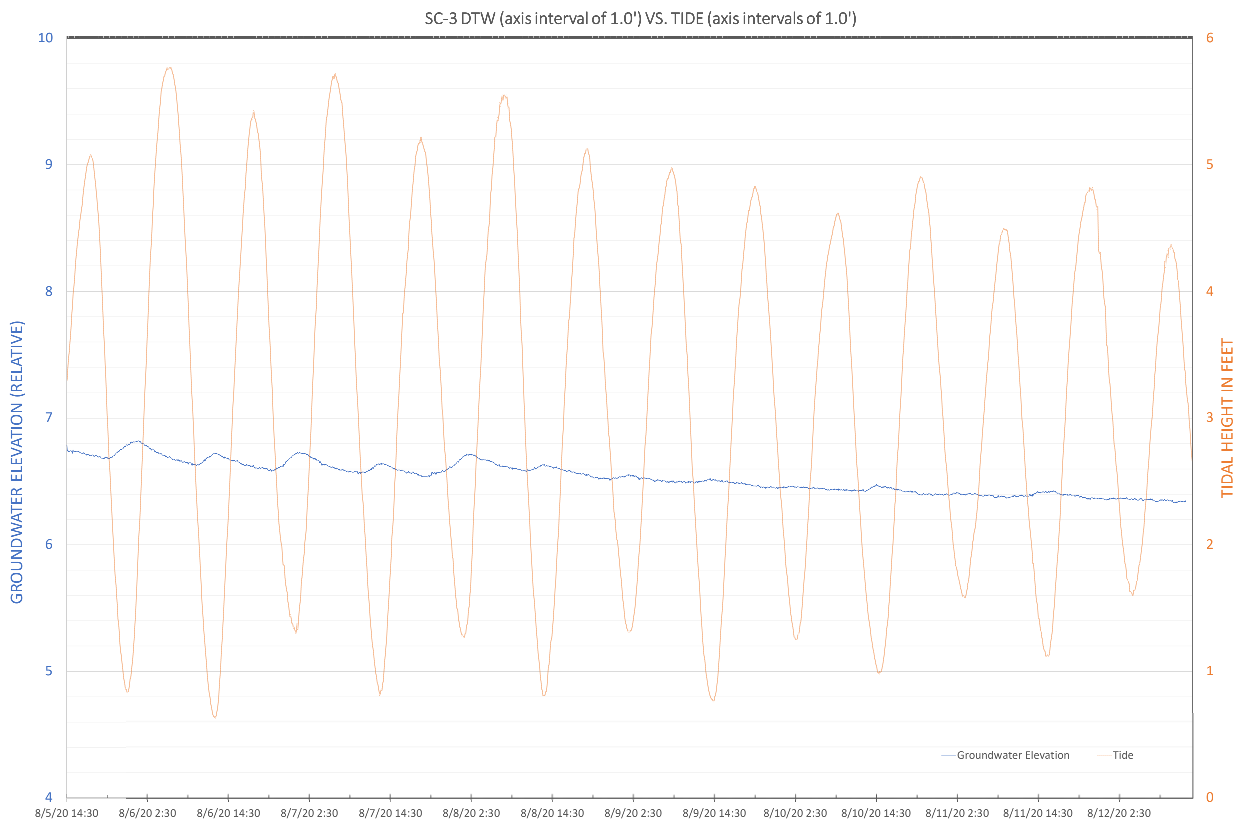
PER-3D DTW (axis interval of 0.1) VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
16.6
16.5
16.4
16.3
16.2
16.1
16
15.9
15.8
15.7
15.6
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 14:02
8/6/20 2:02
8/6/20 14:02
8/7/20 2:02
8/7/20 14:02
8/8/20 2:02
8/8/20 14:02
8/9/20 2:02
8/9/20 14:02
8/10/20 2:02
8/10/20 14:02
8/11/20 2:02
8/11/20 14:02
8/12/20 2:02

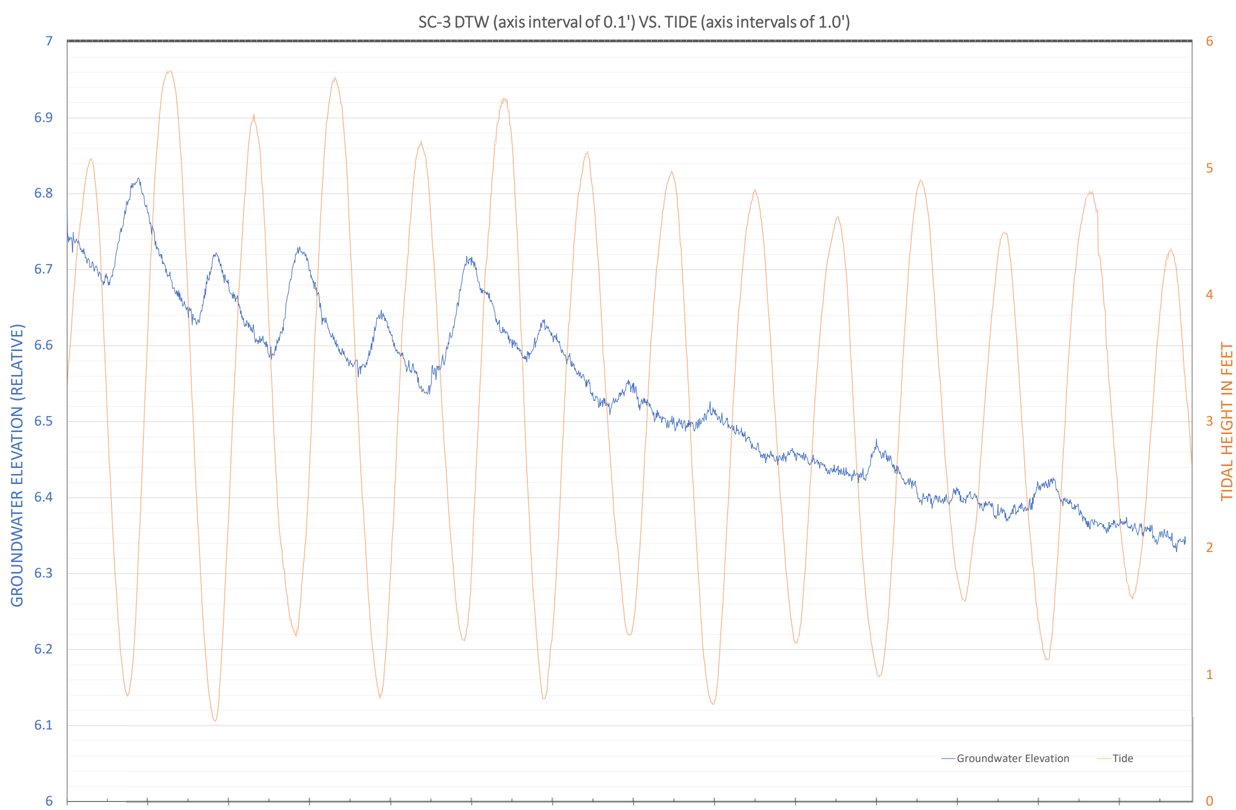
PL-8R


PL-8R DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
20
19
18
17
16
15
14
6
5
4
3
2
1
0
8/5/20 12:43
8/6/20 0:43
8/6/20 12:43
8/7/20 0:43
8/7/20 12:43
8/8/20 0:43
8/8/20 12:43
8/9/20 0:43
8/9/20 12:43
8/10/20 0:43
8/10/20 12:43
8/11/20 0:43
8/11/20 12:43
8/12/20 0:43

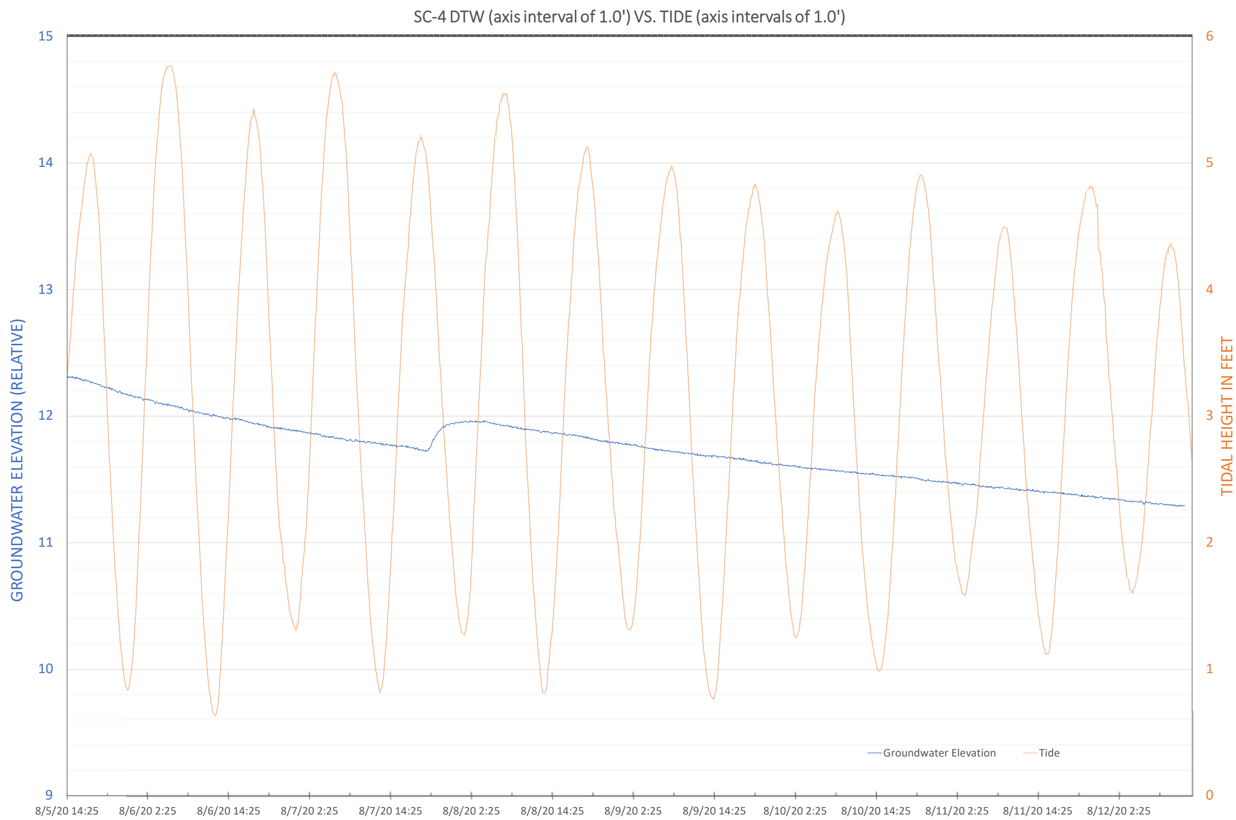

PL-8R DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
17.1
17
16.9
16.8
16.7
16.6
16.5
16.4
16.3
16.2
16.1
6
5
4
3
2
1
0
8/5/20 12:43
8/6/20 0:43
8/6/20 12:43
8/7/20 0:43
8/7/20 12:43
8/8/20 0:43
8/8/20 12:43
8/9/20 0:43
8/9/20 12:43
8/10/20 0:43
8/10/20 12:43
8/11/20 0:43
8/11/20 12:43
8/12/20 0:43

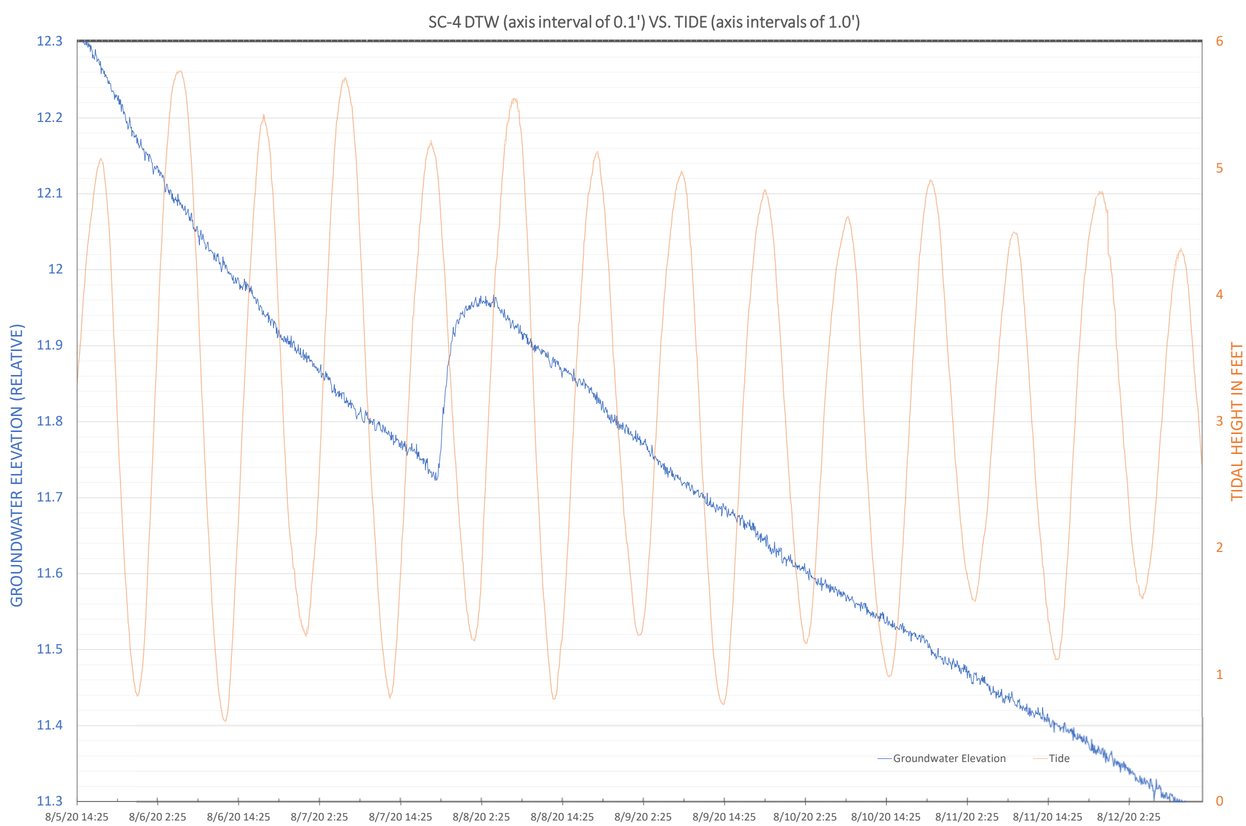
SC-3


SC-3 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
10
9
8
7
6
5
4
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 14:30
8/6/20 2:30
8/6/20 14:30
8/7/20 2:30
8/7/20 14:30
8/8/20 2:30
8/8/20 14:30
8/9/20 2:30
8/9/20 14:30
8/10/20 2:30
8/10/20 14:30
8/11/20 2:30
8/11/20 14:30
8/12/20 2:30

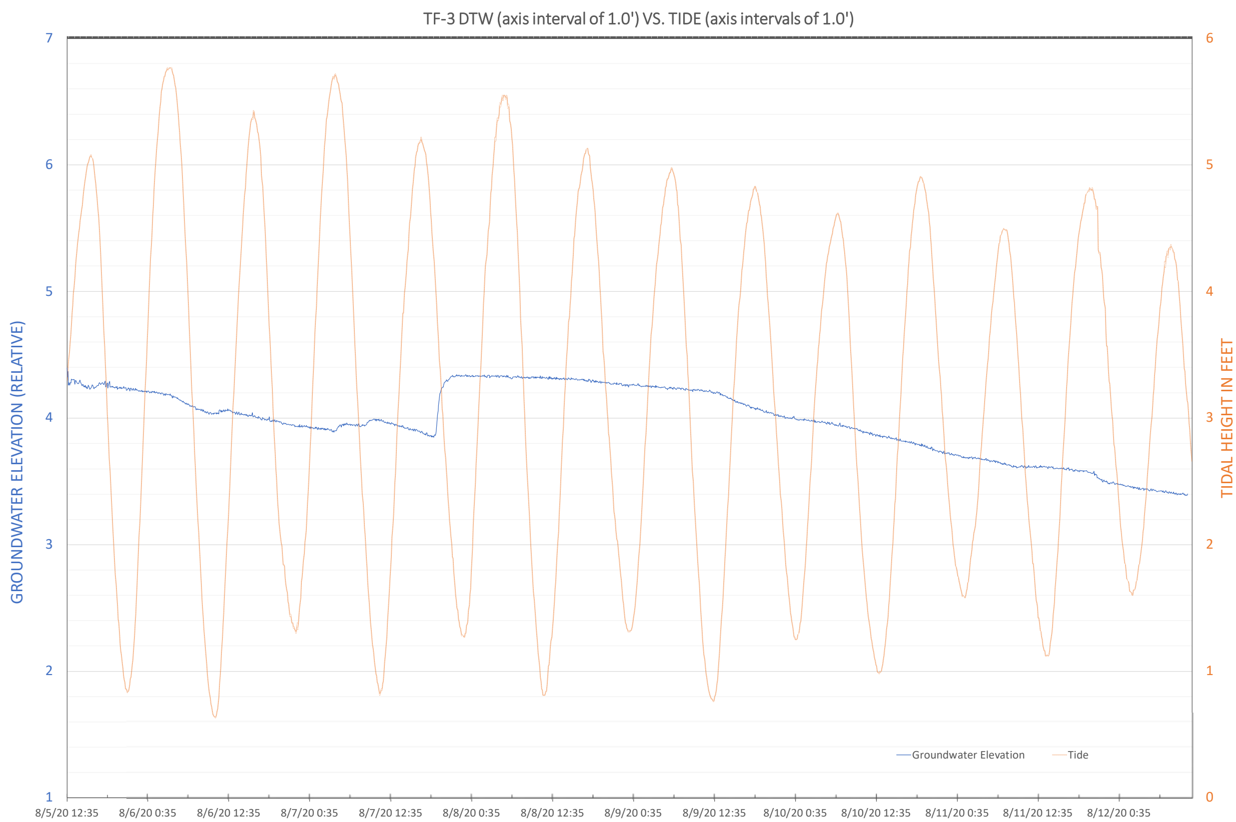

SC-3 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 14:30
8/6/20 2:30
8/6/20 14:30
8/7/20 2:30
8/7/20 14:30
8/8/20 2:30
8/8/20 14:30
8/9/20 2:30
8/9/20 14:30
8/10/20 2:30
8/10/20 14:30
8/11/20 2:30
8/11/20 14:30
8/12/20 2:30

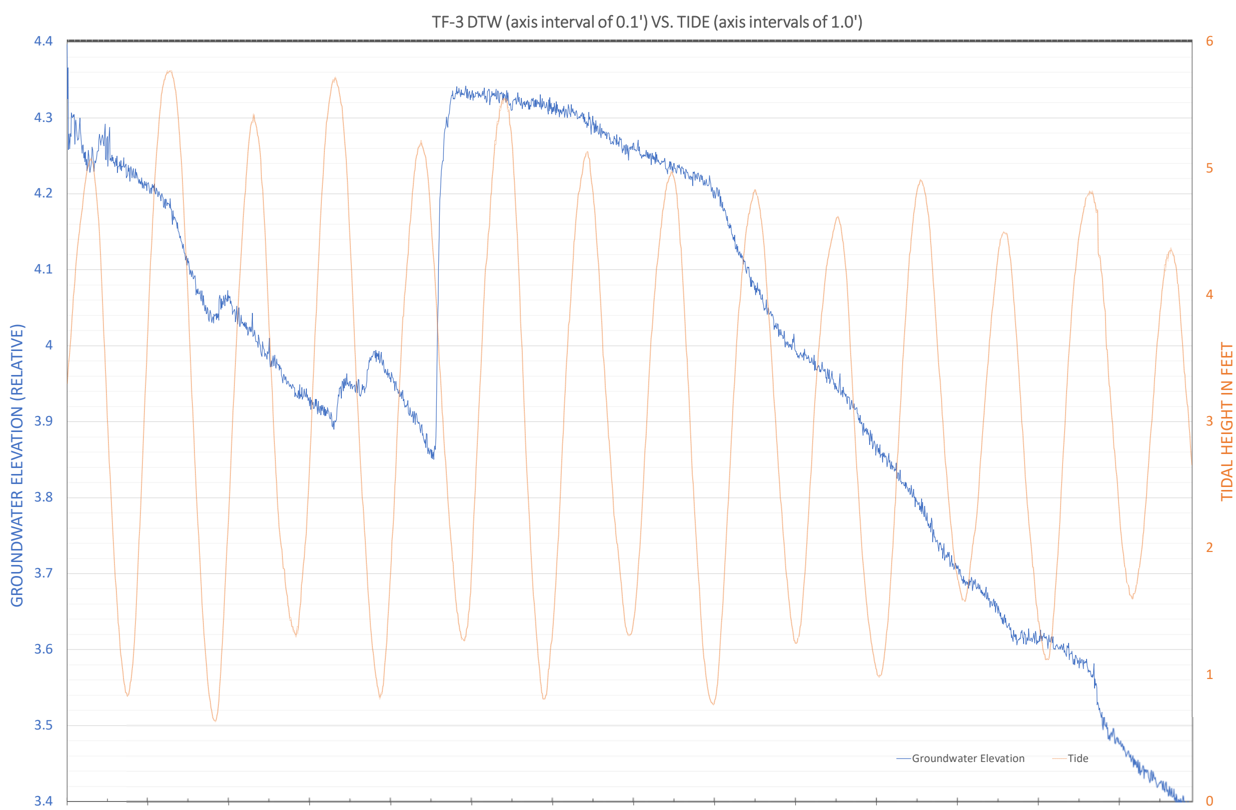
SC-4


SC-4 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
15
14
13
12
11
10
9
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 14:25
8/6/20 2:25
8/6/20 14:25
8/7/20 2:25
8/7/20 14:25
8/8/20 2:25
8/8/20 14:25
8/9/20 2:25
8/9/20 14:25
8/10/20 2:25
8/10/20 14:25
8/11/20 2:25
8/11/20 14:25
8/12/20 2:25

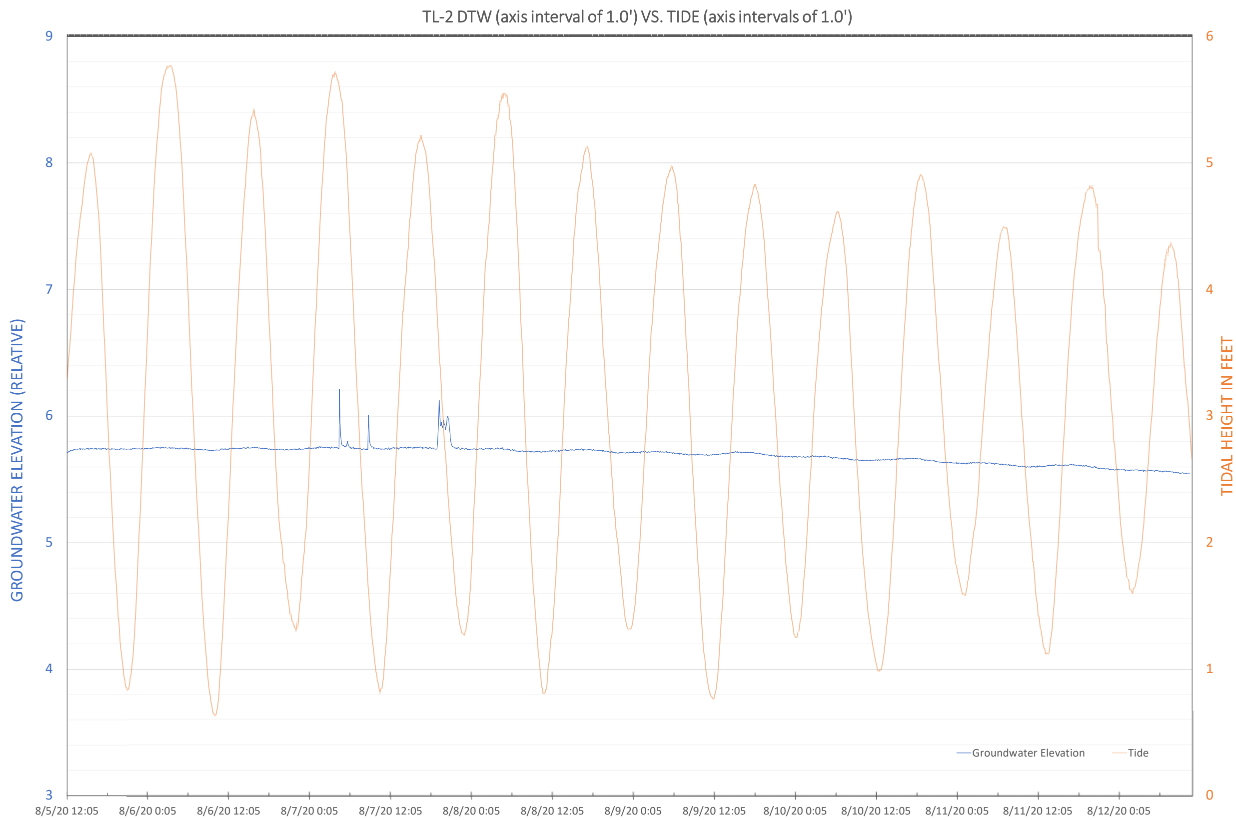

SC-4 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
12.3
12.2
12.1
12
11.9
11.8
11.7
11.6
11.5
11.4
11.3
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 14:25
8/6/20 2:25
8/6/20 14:25
8/7/20 2:25
8/7/20 14:25
8/8/20 2:25
8/8/20 14:25
8/9/20 2:25
8/9/20 14:25
8/10/20 2:25
8/10/20 14:25
8/11/20 2:25
8/11/20 14:25
8/12/20 2:25

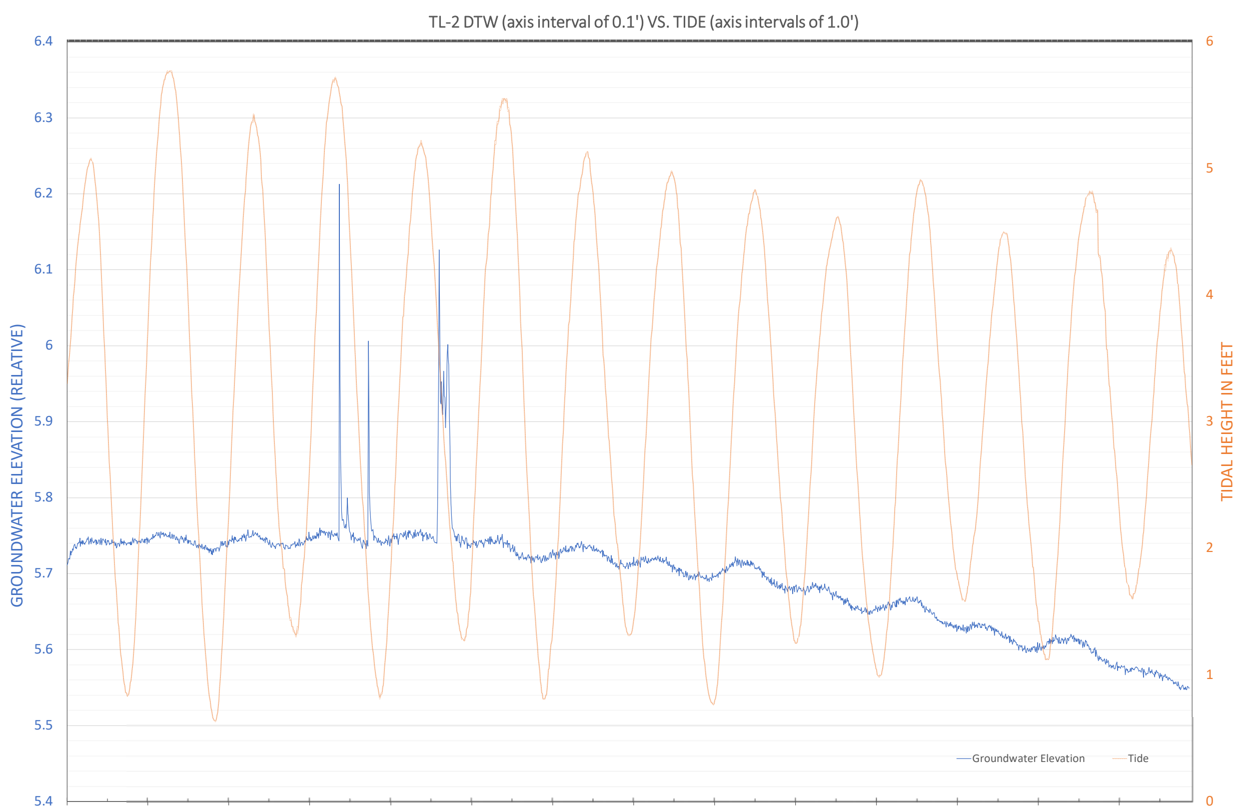
TF-3


TF-3 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
7
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 12:35
8/6/20 0:35
8/6/20 12:35
8/7/20 0:35
8/7/20 12:35
8/8/20 0:35
8/8/20 12:35
8/9/20 0:35
8/9/20 12:35
8/10/20 0:35
8/10/20 12:35
8/11/20 0:35
8/11/20 12:35
8/12/20 0:35

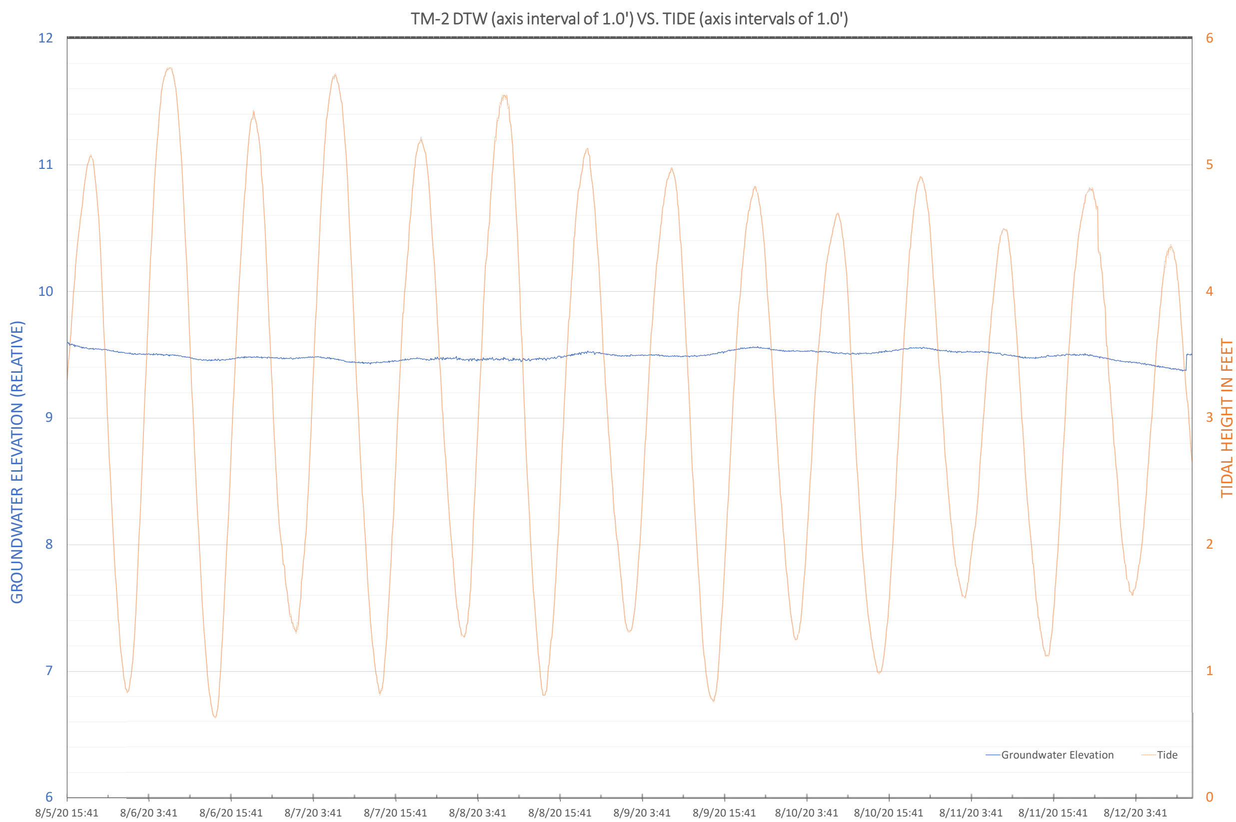

TF-3 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
4.4
4.3
4.2
4.1
4
3.9
3.8
3.7
3.6
3.5
3.4
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 12:35
8/6/20 0:35
8/6/20 12:35
8/7/20 0:35
8/7/20 12:35
8/8/20 0:35
8/8/20 12:35
8/9/20 0:35
8/9/20 12:35
8/10/20 0:35
8/10/20 12:35
8/11/20 0:35
8/11/20 12:35
8/12/20 0:35

TL-2

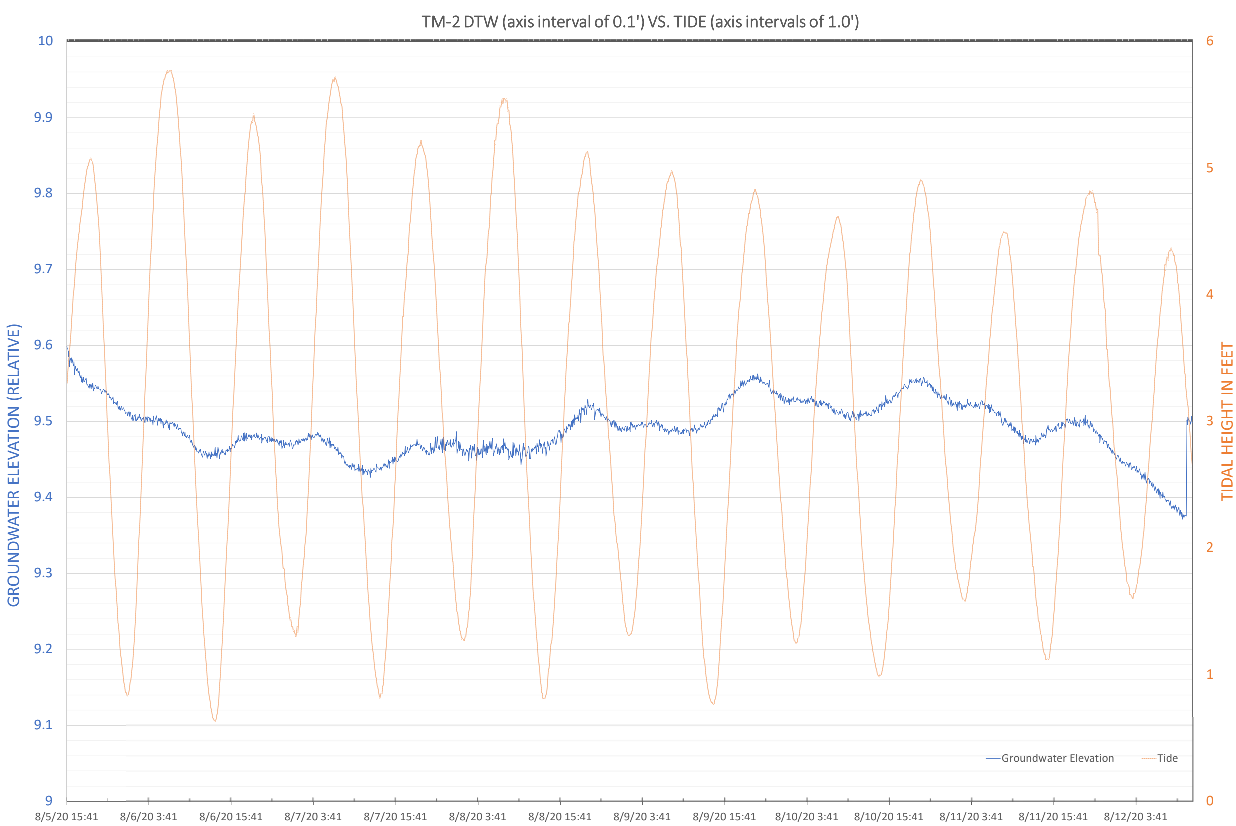

TL-2 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
9
8
7
6
5
4
3
6
5
4
3
2
1
0
8/5/20 12:05
8/6/20 0:05
8/6/20 12:05
8/7/20 0:05
8/7/20 12:05
8/8/20 0:05
8/8/20 12:05
8/9/20 0:05
8/9/20 12:05
8/10/20 0:05
8/10/20 12:05
8/11/20 0:05
8/11/20 12:05
8/12/20 0:05


TL-2 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
6
5
4
3
2
1
0
8/5/20 12:05
8/6/20 0:05
8/6/20 12:05
8/7/20 0:05
8/7/20 12:05
8/8/20 0:05
8/8/20 12:05
8/9/20 0:05
8/9/20 12:05
8/10/20 0:05
8/10/20 12:05
8/11/20 0:05
8/11/20 12:05
8/12/20 0:05

TM-2

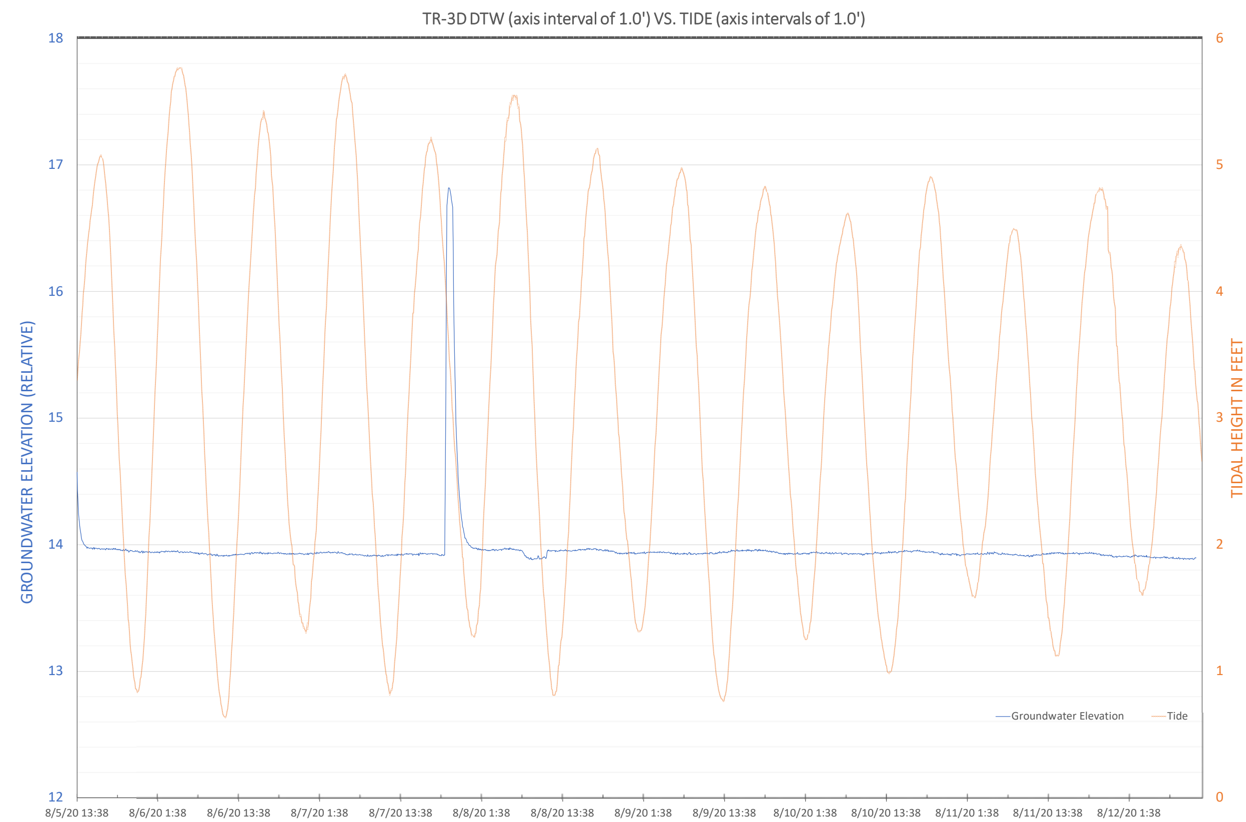


TM-2 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
12
11
10
9
8
7
6
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 15:41
8/6/20 3:41
8/6/20 15:41
8/7/20 3:41
8/7/20 15:41
8/8/20 3:41
8/8/20 15:41
8/9/20 3:41
8/9/20 15:41
8/10/20 3:41
8/10/20 15:41
8/11/20 3:41
8/11/20 15:41
8/12/20 3:41

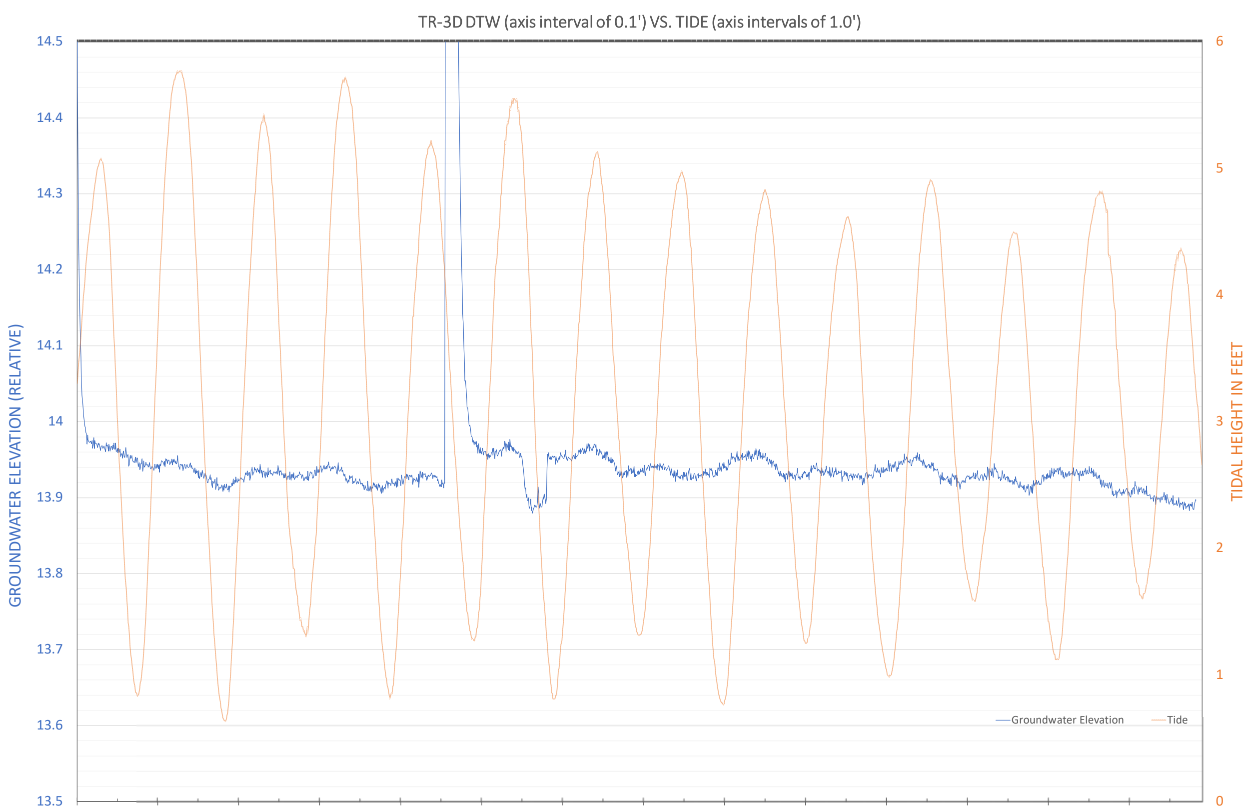


TM-2 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
10
9.9
9.8
9.7
9.6
9.5
9.4
9.3
9.2
9.1
9
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 15:41
8/6/20 3:41
8/6/20 15:41
8/7/20 3:41
8/7/20 15:41
8/8/20 3:41
8/8/20 15:41
8/9/20 3:41
8/9/20 15:41
8/10/20 3:41
8/10/20 15:41
8/11/20 3:41
8/11/20 15:41
8/12/20 3:41

TR-3D

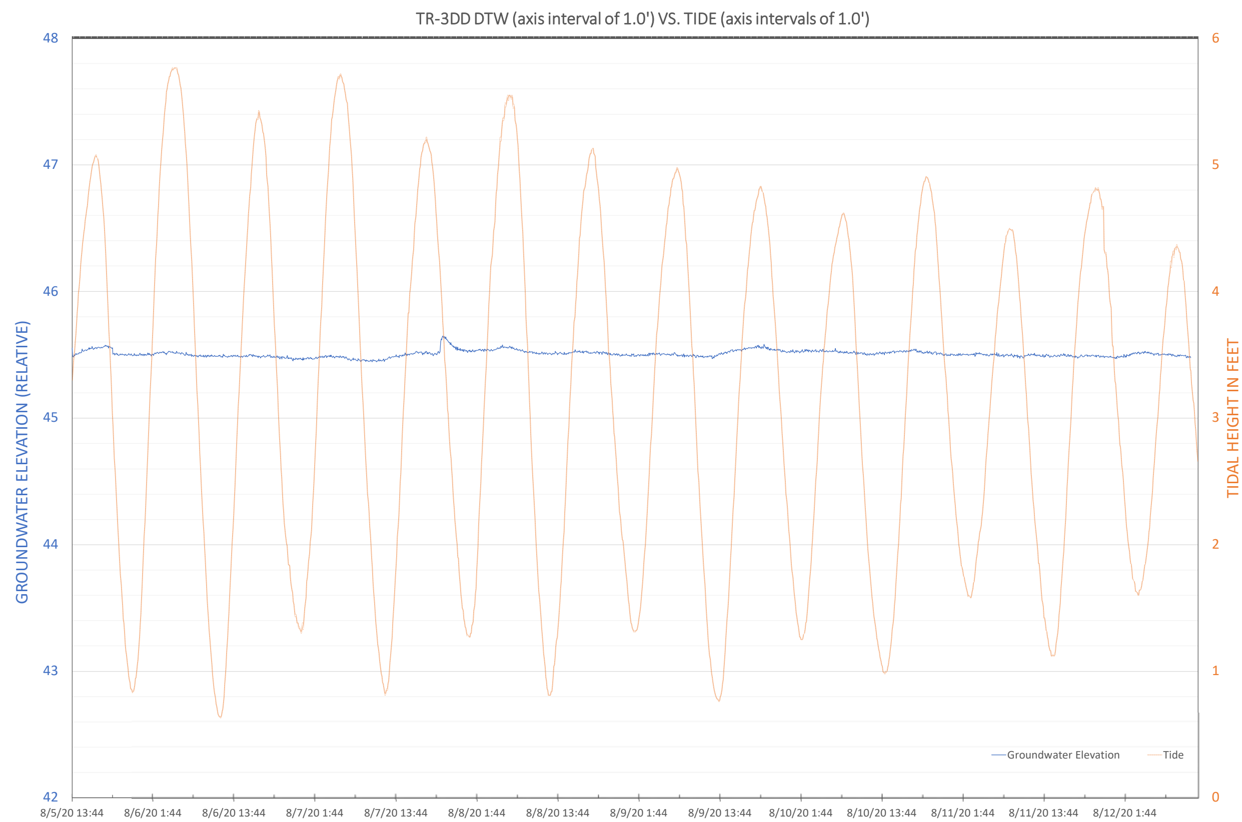


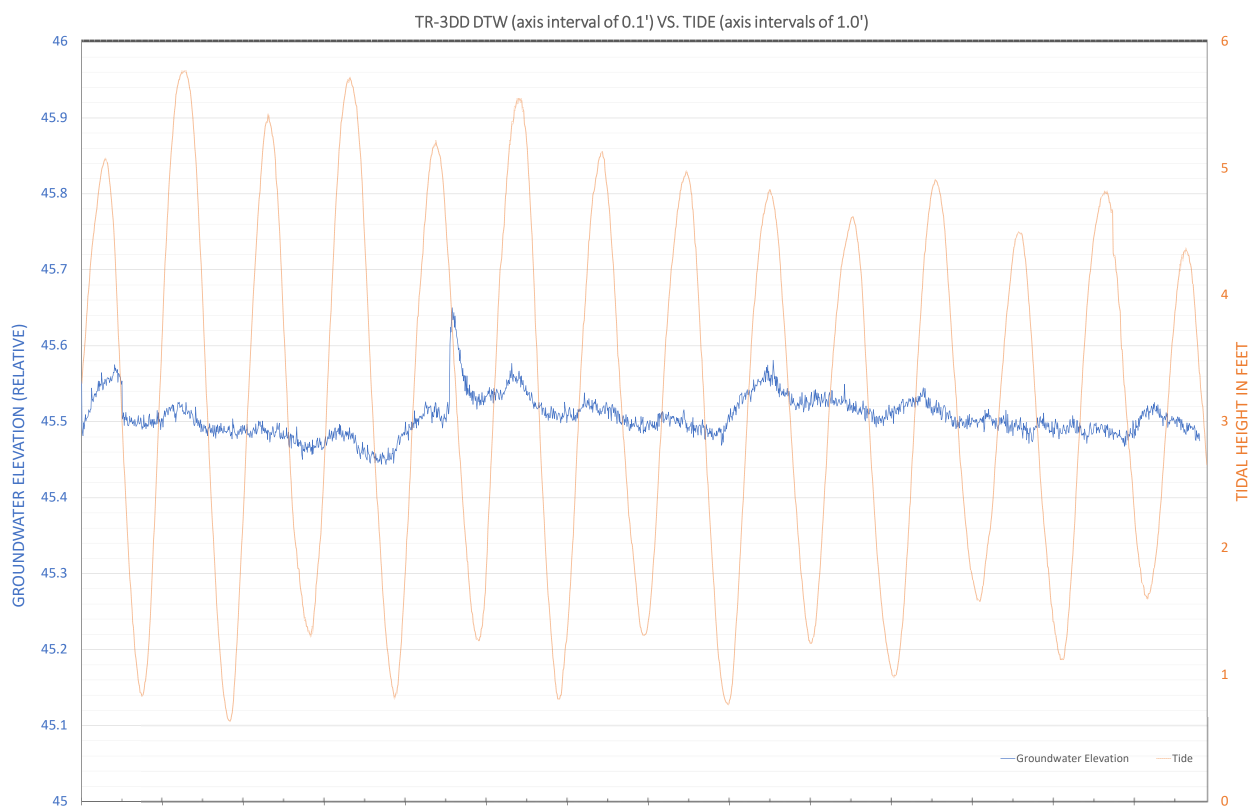
TR-3D DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
18
17
16
15
14
13
12
6
5
4
3
2
1
0
8/5/20 13:38
8/6/20 1:38
8/6/20 13:38
8/7/20 1:38
8/7/20 13:38
8/8/20 1:38
8/8/20 13:38
8/9/20 1:38
8/9/20 13:38
8/10/20 1:38
8/10/20 13:38
8/11/20 1:38
8/11/20 13:38
8/12/20 1:38
Groundwater Elevation
Tide



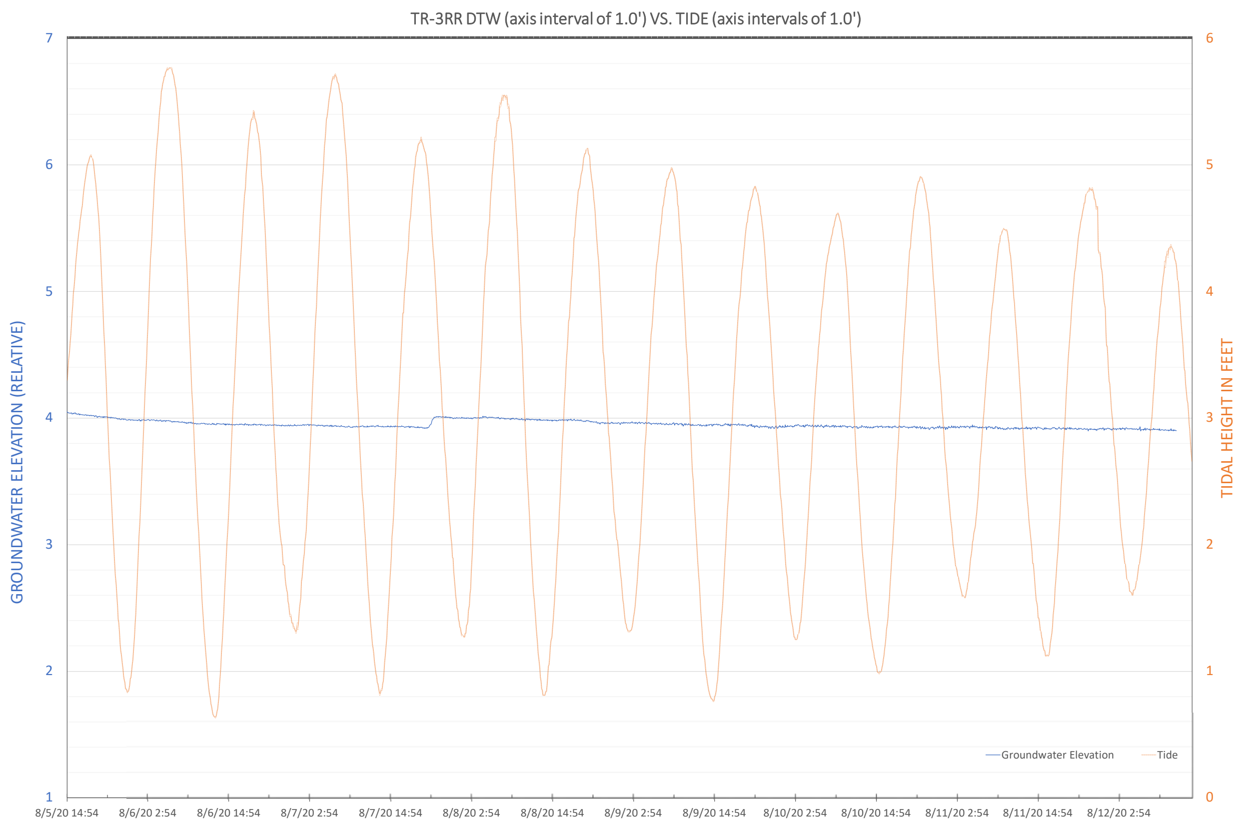
TR-3D DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
14.5
14.4
14.3
14.2
14.1
14
13.9
13.8
13.7
13.6
13.5
6
5
4
3
2
1
0
8/5/20 13:38
8/6/20 1:38
8/6/20 13:38
8/7/20 1:38
8/7/20 13:38
8/8/20 1:38
8/8/20 13:38
8/9/20 1:38
8/9/20 13:38
8/10/20 1:38
8/10/20 13:38
8/11/20 1:38
8/11/20 13:38
8/12/20 1:38
Groundwater Elevation
Tide

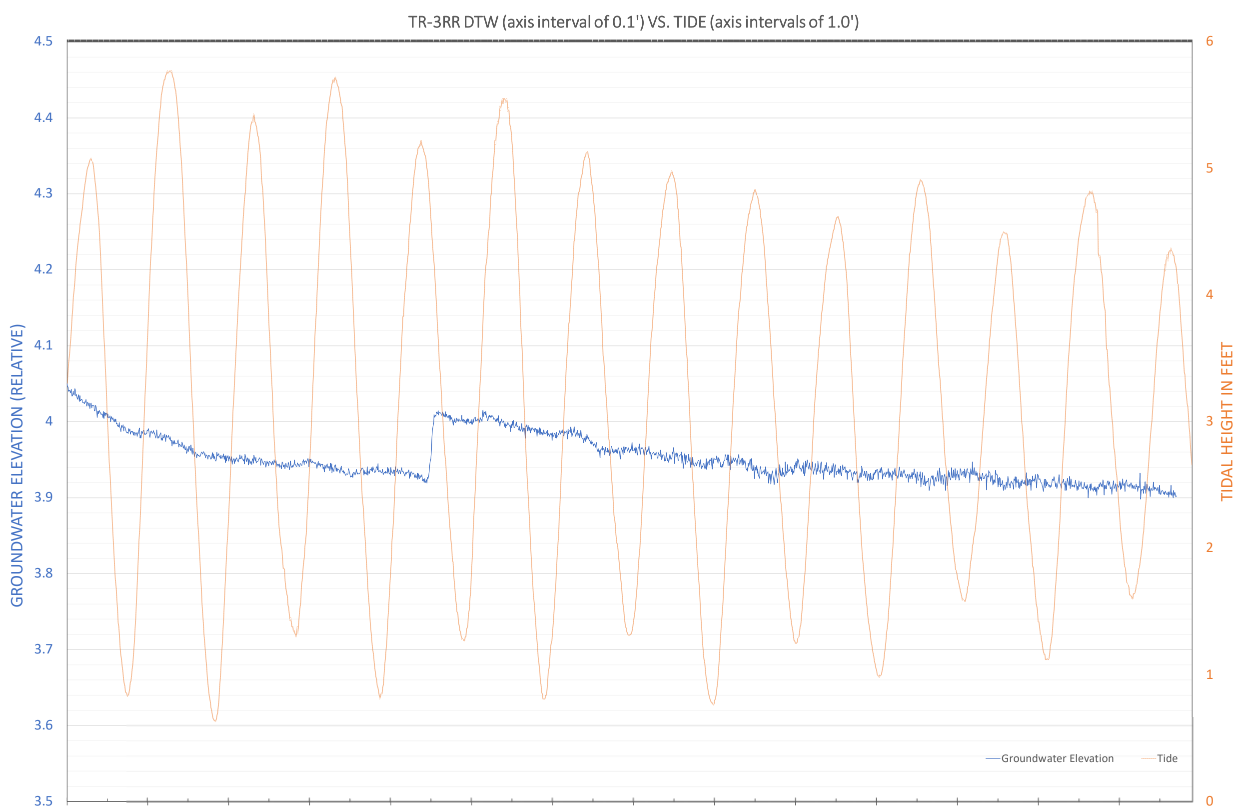
TR-3DD


TR-3DD DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
48
47
46
45
44
43
42
6
5
4
3
2
1
0
8/5/20 13:44
8/6/20 1:44
8/6/20 13:44
8/7/20 1:44
8/7/20 13:44
8/8/20 1:44
8/8/20 13:44
8/9/20 1:44
8/9/20 13:44
8/10/20 1:44
8/10/20 13:44
8/11/20 1:44
8/11/20 13:44
8/12/20 1:44
Groundwater Elevation
Tide

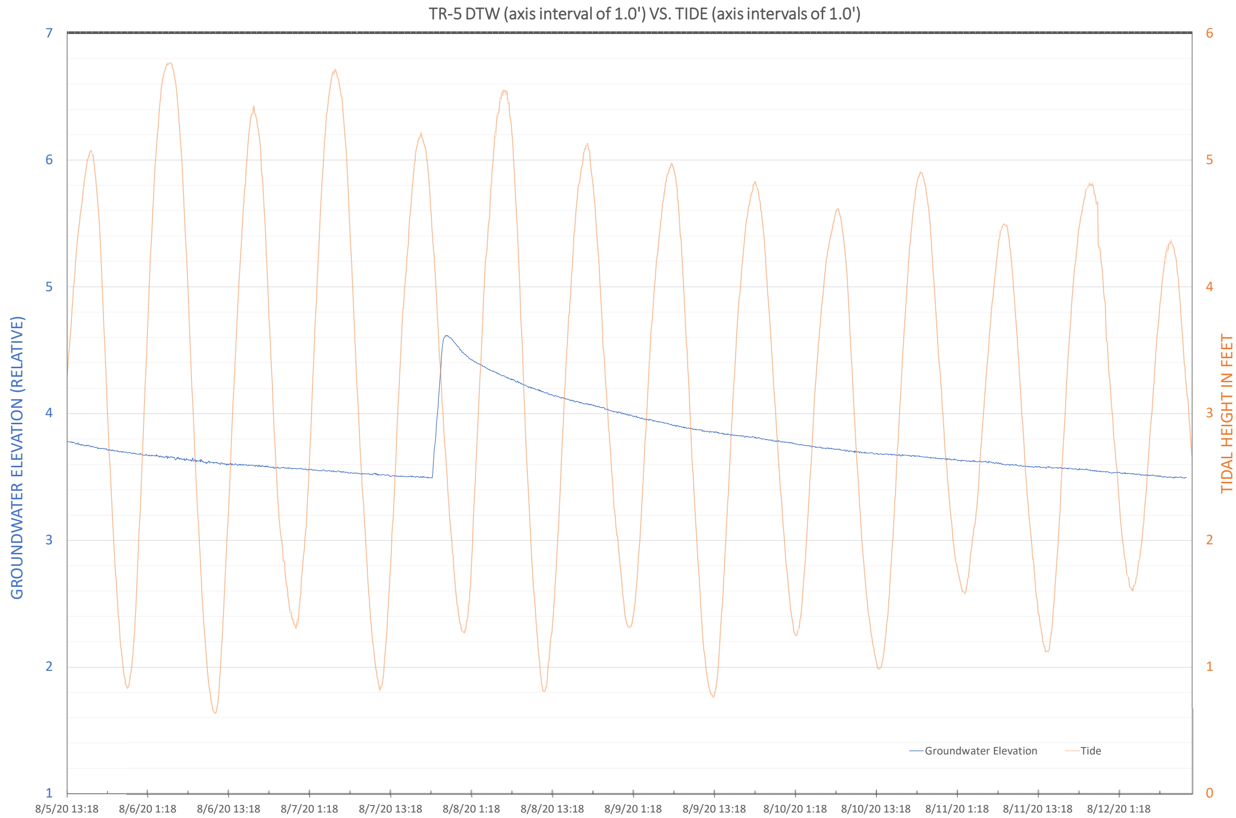

TR-3DD DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
46
45.9
45.8
45.7
45.6
45.5
45.4
45.3
45.2
45.1
45
6
5
4
3
2
1
0
8/5/20 13:44
8/6/20 1:44
8/6/20 13:44
8/7/20 1:44
8/7/20 13:44
8/8/20 1:44
8/8/20 13:44
8/9/20 1:44
8/9/20 13:44
8/10/20 1:44
8/10/20 13:44
8/11/20 1:44
8/11/20 13:44
8/12/20 1:44
Groundwater Elevation
Tide

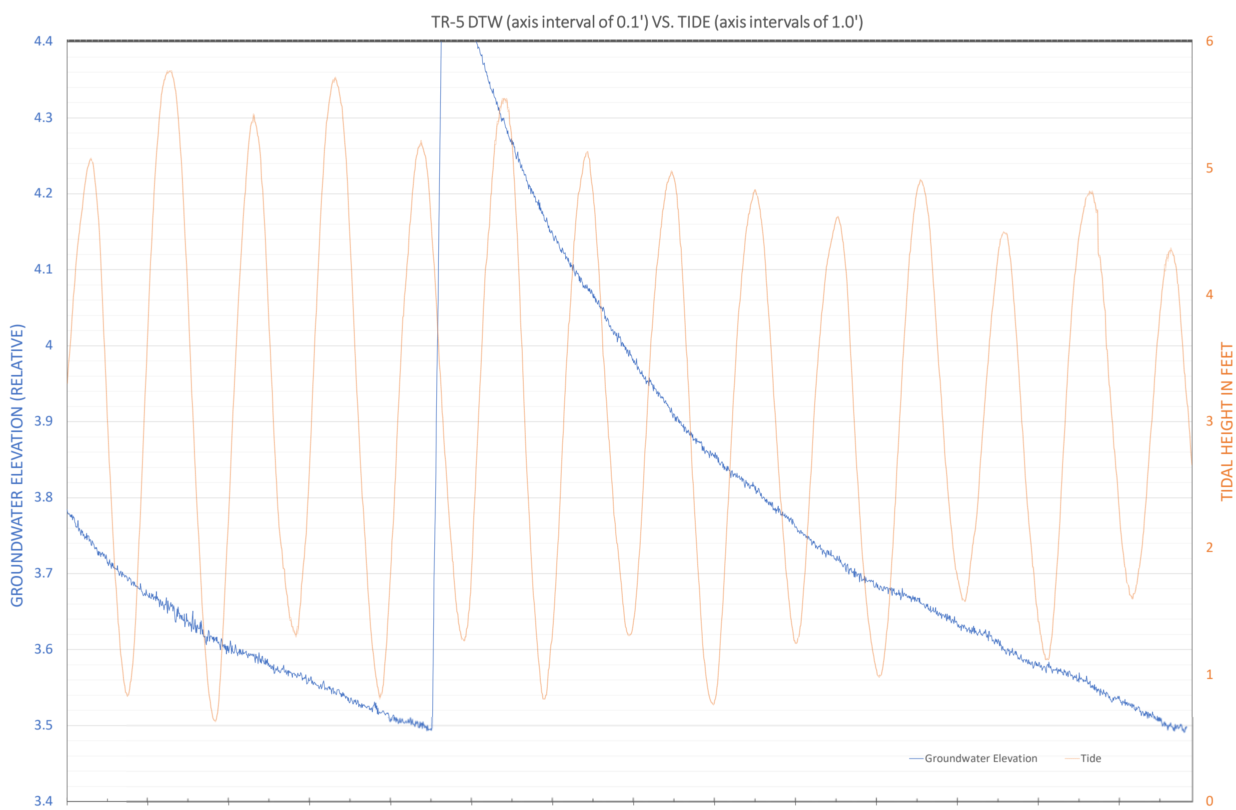
TR-3RR


TR-3RR DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
8/5/20 14:54
8/6/20 2:54
8/6/20 14:54
8/7/20 2:54
8/7/20 14:54
8/8/20 2:54
8/8/20 14:54
8/9/20 2:54
8/9/20 14:54
8/10/20 2:54
8/10/20 14:54
8/11/20 2:54
8/11/20 14:54
8/12/20 2:54

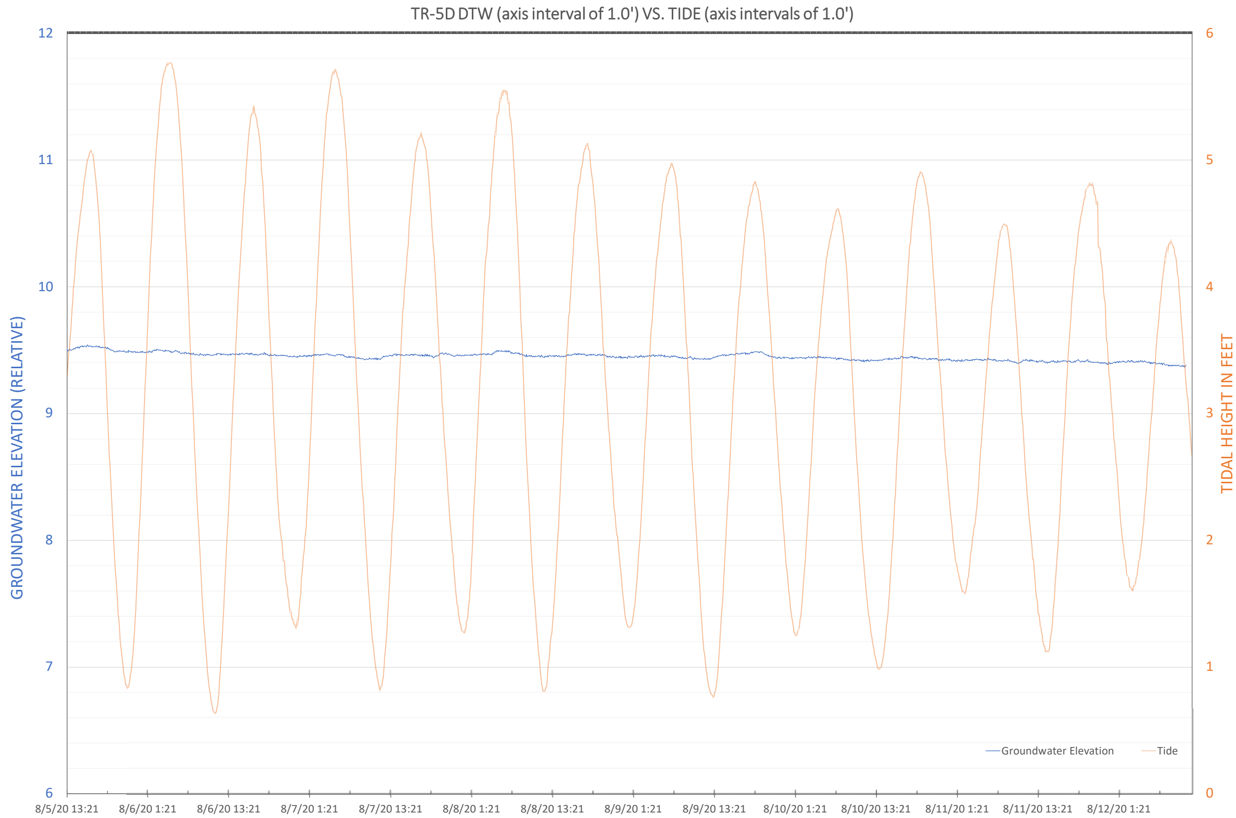

TR-3RR DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
8/5/20 14:54
8/6/20 2:54
8/6/20 14:54
8/7/20 2:54
8/7/20 14:54
8/8/20 2:54
8/8/20 14:54
8/9/20 2:54
8/9/20 14:54
8/10/20 2:54
8/10/20 14:54
8/11/20 2:54
8/11/20 14:54
8/12/20 2:54

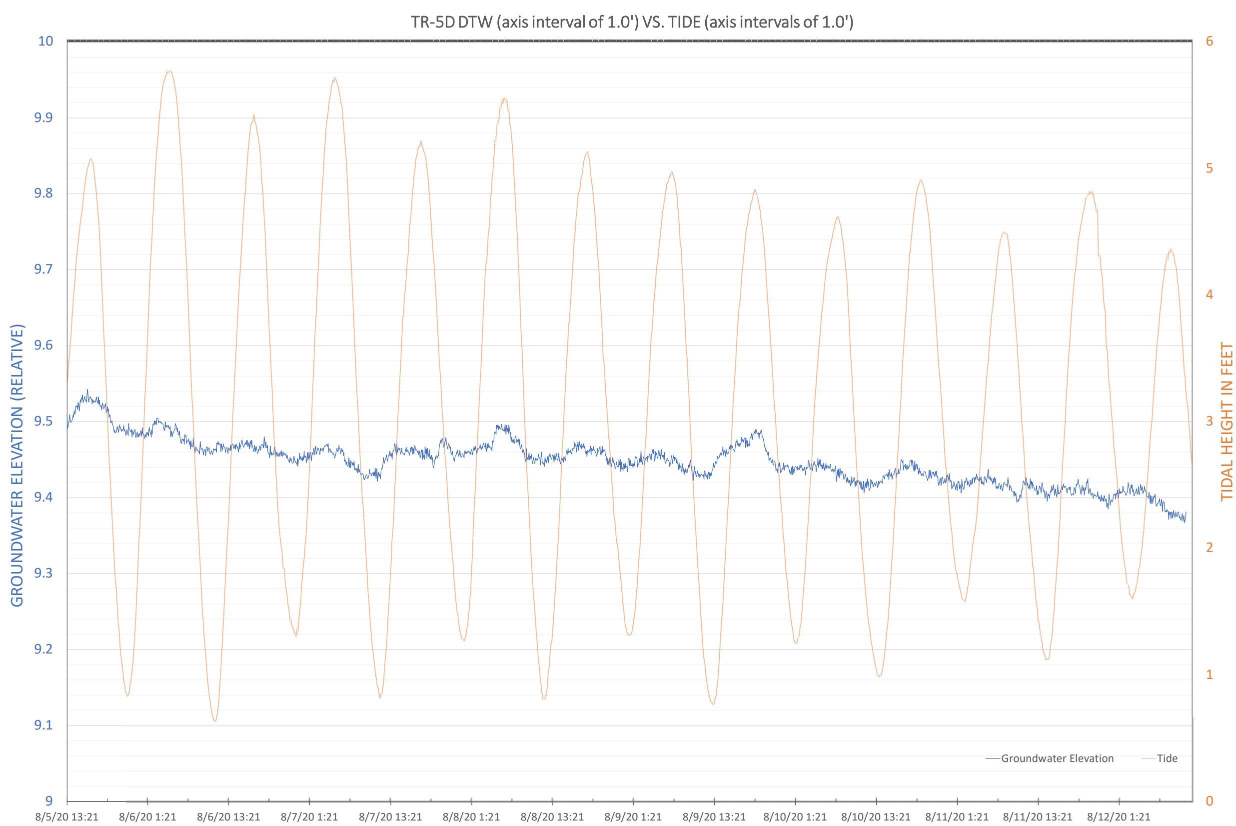
TR-5


TR-5 DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
8/5/20 13:18
8/6/20 1:18
8/6/20 13:18
8/7/20 1:18
8/7/20 13:18
8/8/20 1:18
8/8/20 13:18
8/9/20 1:18
8/9/20 13:18
8/10/20 1:18
8/10/20 13:18
8/11/20 1:18
8/11/20 13:18
8/12/20 1:18


TR-5 DTW (axis interval of 0.1') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
Groundwater Elevation
Tide
8/5/20 13:18
8/6/20 1:18
8/6/20 13:18
8/7/20 1:18
8/7/20 13:18
8/8/20 1:18
8/8/20 13:18
8/9/20 1:18
8/9/20 13:18
8/10/20 1:18
8/10/20 13:18
8/11/20 1:18
8/11/20 13:18
8/12/20 1:18

TR-5D


TR-5D DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
12
11
10
9
8
7
6
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 13:21
8/6/20 1:21
8/6/20 13:21
8/7/20 1:21
8/7/20 13:21
8/8/20 1:21
8/8/20 13:21
8/9/20 1:21
8/9/20 13:21
8/10/20 1:21
8/10/20 13:21
8/11/20 1:21
8/11/20 13:21
8/12/20 1:21


TR-5D DTW (axis interval of 1.0') VS. TIDE (axis intervals of 1.0')
GROUNDWATER ELEVATION (RELATIVE)
TIDAL HEIGHT IN FEET
10
9.9
9.8
9.7
9.6
9.5
9.4
9.3
9.2
9.1
9
6
5
4
3
2
1
0
Groundwater Elevation
Tide
8/5/20 13:21
8/6/20 1:21
8/6/20 13:21
8/7/20 1:21
8/7/20 13:21
8/8/20 1:21
8/8/20 13:21
8/9/20 1:21
8/9/20 13:21
8/10/20 1:21
8/10/20 13:21
8/11/20 1:21
8/11/20 13:21
8/12/20 1:21

Attachment E

May 2020 Groundwater Vertical Gradient Calculator Results Table

Table E-1:
May 2020 Groundwater Vertical Gradient Calculator Results Table

Monitoring Well	Input Parameters				Flow Direction Results (as per the EPA vertical gradient calculator)	Notes
	Surface Elevation	Depth to Well Screen	Screen Length	Depth to Water		
AD-3	17.11	1	10	9.81	Down	
AD-3D	16.99	24	5	9.84		
AD-5	15.84	2	13	6.12	Down	
AD-5D	15.77	25	5	7.88		
AD-9D	15.73	23	5	7.86	Down	
AD-9DD	15.72	55	5	9.56		
AD-10	16.47	5	15	8.59	Down	
AD-10DD	16.48	59	5	8.76		
PER-2	8.01	2	7	5.57	Down	
PER-2D	8.2	25	5	6.26		
PER-2D	8.2	25	5	6.26	Down	
PER-2DD	8.02	50	10	6.5		
PER-2	8.01	2	7	5.57	Down	
PER-2DD	8.02	50	10	6.5		
PER-3	4.38	2	7	4.34	Down	
PER-3D	4.66	23	7	5.7		
PER-9	5.4	1	14	5.32	Down	
PER-9D	5.57	25	5	5.84		
PER-9D	5.57	25	5	5.84	Up	
PER-9DD	5.54	60	5	5.44		
PER-9	5.4	1	14	5.32	Up	
PER-9DD	5.54	60	5	5.44		
PER-10	8.58	3	12	7.28	Down	
PER-10D	8.74	25	5	10.39		
TR-3RR	9.91	1	14	2.77	Up	
TR-3D	9.7	15	10	2.37		
TR-3D	9.7	15	10	2.37	Down	
TR-3DD	10.03	50	10	3.23		
TR-3RR	9.91	1	14	2.77	Down	
TR-3DD	10.03	50	10	3.23		
TR-4R	12.79	1	14	1.52	Down	
TR-4D	12.7	25	5	2.35		
TR-5	12.22	2	10	3.77	Down	
TR-5D	11.9	15	10	5.16		
TR-5D	11.9	15	10	5.16	Down	
TR-5DD	11.53	50	10	5.02		
TR-5	12.22	2	10	3.77	Down	
TR-5DD	11.53	50	10	5.02		
TR-6	10.88	2	10	3.81	Down	
TR-6D	10.95	25	5	4.26		
SC-1	5.13	5	10	1.8	Up	SC-1 well cluster was saturated in puddle
SC-1D	5.03	20	10	0		
SC-1D	5.03	20	10	0	Up	
SC-1DD	5.08	50	10	0		
SC-1	5.13	5	10	1.8	Up	
SC-1DD	5.08	50	10	0		
SC-2	5.07	5	10	1.9	Down	
SC-2D	4.77	25	10	2.52		
SC-2D	4.77	25	10	2.52	Up	
SC-2DD	4.79	50	10	2.45		
SC-2DD	4.79	50	10	2.45	Up	
SC-2DDD	4.65	68	10	2.2		
SC-2	5.07	5	10	1.9	Down	
SC-2DDD	4.65	68	10	2.2		
SC-3	4.08	4	10	4.91	Down	
SC-3D	3.84	25	10	5.11		
SC-3D	3.84	25	10	5.11	Down	
SC-3DD	3.8	55	10	5.39		
SC-3DD	3.8	55	10	5.39	Down	
SC-3DDD	3.89	71	10	5.55		
SC-3	4.08	4	10	4.91	Down	
SC-3DDD	3.89	71	10	5.55		
SC-4	7.28	5	10	3.34	Down	
SC-4D	7.28	25	10	5.81		
SC-4D	7.28	25	10	5.81	Up	
SC-4DD	7.11	50	10	5.62		
SC-4	7.28	5	10	3.34	Down	
SC-4DD	7.11	50	10	5.62		

Attachment F

LNAPL & Groundwater Recovery
Summary Table

Attachment F
Monitoring Well Gauging Table - Historic LNAPL
Hess Corporation - Former Port Reading Complex
750 Cliff Road
Port Reading, Middlesex County, New Jersey

First Quarter	2015			2016			2017			2018			2019			2020		
	January	February	March	January	February	March	January	February	March	January	February	March	January	February	March	January	February	March
PL-1RR	0.00	0.00	0.00	Sheen	Sheen	Sheen	Sheen	Sheen	Sheen	0.00	0.02	Sheen	0.00	0.00	0.00	0.00	0.00	0.00
PL-2	0.02	0.02	0.02	Sheen	Sheen	Sheen	Sheen	Sheen	Sheen	Sheen	Sheen	Sheen	0.00	0.00	0.00	0.00	0.00	0.00
PL-5/PL-5R	NA	NA	NA	NA	NA	NA	0.00	0.00	0.00	1.63	NM	1.25	0.02	0.00	0.00	0.00	0.00	0.00
TF-1	NM	NM	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TF-2	NM	NM	0.24	NM	NM	NM	0.02	NM	NM	0.02	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00
TM-7	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00
TR-2R	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00
TR-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TR-6D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Second Quarter	2015			2016			2017			2018			2019			2020		
	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June	April	May	June
PL-1RR	NM	NM	0.00	Sheen	Sheen	Sheen	0.00	Sheen	0.01	Sheen	Sheen	NM	0.00	0.00	0.00	0.00	Sheen	0.00
PL-2	NM	NM	0.05	0.00	Sheen	0.00	Sheen	Sheen	Sheen	Sheen	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00
PL-5/PL-5R	NA	NA	NA	NA	NA	NA	0.00	0.00	NM	1.00	0.00	NM	Sheen	Sheen	Sheen	0.00	0.00	0.20
TF-1	NM	NM	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00
TF-2	NM	NM	0.01	0.60	0.60	0.58	NM	NM	NM	NM	NM	NM	0.00	0.00	0.00	0.00	0.00	0.00
TM-7	NM	NM	0.01	Sheen	Sheen	0.05	0.00	0.00	0.00	NM	0.00	NM	0.00	0.00	0.00	0.00	Sheen	0.00
TR-2R	NM	NM	0.01	0.07	0.08	0.07	0.00	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	Sheen	0.00
TR-6	NM	NM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00
TR-6D	NM	NM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00

Third Quarter	2015			2016			2017			2018			2019			2020		
	July	August	September	July	August	September	July	August	September	July	August	September	July	August	September	July	August	September
PL-1RR	0.01	0.01	0.17	Sheen	Sheen	Sheen	Sheen	Sheen	Sheen	0.00	0.00	0.00	0.00	N/A	0.00	Sheen	Sheen	Sheen
PL-2	0.02	0.02	0.04	0.00	0.00	0.00	Sheen	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00	0.00	0.00	0.00
PL-5/PL-5R	NA	NA	NA	NA	NA	NA	NM	Sheen	Sheen	1.50	1.35	1.75	indeterminable	N/A	NM	0.00	0.70	0.25
TF-1	NM	NM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00	Sheen	Sheen	Sheen
TF-2	NM	NM	NM	0.50	0.38	0.28	0.01	Sheen	0.00	0.00	Sheen	0.00	0.00	N/A	0.00	Sheen	Sheen	Sheen
TM-7	0.05	0.07	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00	Sheen	Sheen	0.00	N/A	0.00	Sheen	Sheen	Sheen
TR-2R	0.01	0.01	0.02	0.03	Sheen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00	Sheen	Sheen	Sheen
TR-6	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00	0.00	0.00	0.00
TR-6D	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00	0.00	0.00	0.00

Fourth Quarter	2015			2016			2017			2018			2019		
	October	November	December	October	November	December	October	November	December	October	November	December	October	November	December
PL-1RR	0.11	0.10	0.01	Sheen	NM	Sheen	Sheen	0.02	0.02	0.00	0.00	0.00	0.00	N/A	0.00
PL-2	0.02	0.10	0.01	0.03	NM	0.00	Sheen	Sheen	Sheen	0.00	0.00	0.00	0.00	N/A	0.00
PL-5/PL-5R	NA	NA	NA	NA	NA	NA	NM	1.10	0.57	0.01	0.00	0.00	indeterminable	N/A	NM
TF-1	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00
TF-2	NM	0.50	0.10	0.20	NM	0.02	NM	0.03	0.03	0.01	0.00	0.00	0.00	N/A	0.00
TM-7	0.01	0.00	0.00	0.00	NM	0.00	0.00	0.00	Sheen	0.00	0.00	0.00	0.00	N/A	0.00
TR-2R	0.03	0.00	0.01	0.00	NM	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	N/A	0.00
TR-6	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00
TR-6D	0.00	0.00	0.00	0.00	NM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	0.00

Attachment F
Port Reading Petroleum Impacted
Water Vacout Table
Hess Corporation - Former Port Reading Complex
750 Cliff Road, Port Reading, New Jersey

Port Reading Petroleum Impacted Water Vacout Table	
Quarterly Report	Gallons of Petroleum Impacted Groundwater
4th Quarter 2020	157
3rd Quarter 2020	229
2nd Quarter 2020	150
1st Quarter 2020	307
4th Quarter 2019	278
3rd Quarter 2019	157
2nd Quarter 2019	722
1st Quarter 2019	228
4th Quarter 2018	1346
3rd Quarter 2018	2875
2nd Quarter 2018	55
1st Quarter 2018	437
4th Quarter 2017	43090
3rd Quarter 2017	No vac events done this quarter
2nd Quarter 2017	4967
1st Quarter 2017	20
4th Quarter 2016	30
3rd Quarter 2016	280
2nd Quarter 2016	only passive measures are mentioned in the report - no mention of vac events
1st Quarter 2016	only passive measures are mentioned in the report - no mention of vac events

Attachment G

Wetlands Description Report

RAMBOLL

ENVIRONMENT
& HEALTH

MEMO

Date	**December 2, 2020**
Project no.	**1940072854**
Client	**Earth Systems**
To	**Amy Blake, Earth Systems**
From	**Michael Rondinelli, Ramboll**
	Owen Zalme, Ramboll
Subject	**Wetlands Characterization in Support of the Conceptual Site Model** **Hess Corporation – Former Port Reading Complex** **Port Reading, Middlesex County, New Jersey**

Date December 2, 2020

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1 Background

On October 29, 2020, Earth Systems Environmental Engineering (Earth Systems) requested support from Ramboll U.S. Consulting, Inc. (Ramboll) to provide a technical memorandum that describes and characterizes wetland features identified at the Hess Corporation (Hess) – Former Port Reading Complex (HC-PR) Facility located at 750 Cliff Road in Woodbridge Township, New Jersey, hereby referred to as the "Site". This request was made to supplement Earth Systems' Conceptual Site Model (CSM) report with observations and characterization descriptions of wetland resources at the Site using data gathered during field efforts at the Site from 2012 to 2020. The updated CSM will be submitted to the New Jersey Department of Environmental Protection (NJDEP). Field efforts conducted at the Site focused wholly or partially on the identification of wetlands include the following:

- **2012-2013 Wetland Delineation & Habitat Impact Assessment** – A wetland delineation and habitat impact assessment was conducted in 2012 and 2013 for a portion of the Site in support of permitting efforts for a proposed rail expansion;
- **2019 Landfarm Wetland Delineations** – A wetland delineation was conducted on September 26, 2019 to identify wetlands and define permitting requirements for the construction of an environmental cap in Area of Concern (AOC) 3 (No. 1 Landfarm 1 [LF1]). An additional delineation was conducted on October 24, 2019 at AOC 1 (North Landfarm [NLF]) in support of possible future permitting efforts;
- **2019 Ecological Reconnaissance** – Reconnaissance-level ecological surveys conducted in 2019 of various natural resource features to support the planning for a Site-wide Ecological Evaluation (EE); and
- **2020 Detention Basin & Drainage Ditch Wetland Delineations** – A wetland delineation was conducted on February 5, 2020 in the AOC 12 Detention Basin area and in the northern portion of the North Drainage Ditch (Arthur Kill tributary) in support of the Site-wide EE.

The CSM report is intended to document the conditions and the physical, chemical, and biological processes that control the transport, migration, and potential impacts of site-related contaminants to soils, air, groundwater, surface water, and sediments to human and ecological receptors. The overall objective of this technical memorandum is to assist in the understanding of contaminant migration and fate processes in environmental media within wetland systems identified at the Site through a focused characterization of these wetland habitats.

2 Onsite Wetland Characterization

As described above, several natural resource characterization investigations have been conducted at the Site spanning the 2012 to 2020 timeframe. These investigations have focused primarily on characterization of both inland freshwater and coastal wetland features at the Site to support New Jersey permitting and remediation requirements. Wetland determination data forms and photographs have been used to document the wetland characterization efforts conducted at the Site in 2012/2013, 2019, and 2020. These wetland data forms and photographs are attached to this report as Attachments A and B, respectively. The observations and results from the wetland characterization efforts are presented in the subsections below.

The United States Fish and Wildlife Service National Wetlands Inventory (NWI) provides detailed information on the abundance, characteristics, and distribution of U.S. wetlands. The NWI identifies three wetland types at the Site:

- Palustrine, emergent, semi-permanently flooded, diked/impounded wetland (PEM5Fh)
- Palustrine, unconsolidated bottom, permanently flooded, diked/impounded, excavated wetland (PUBHx)
- Estuarine, intertidal, emergent, persistent, regularly flooded wetland (E2EM1N)

Approximate boundaries of wetland features across the Site were also evaluated through a data query of NJDEP's online environmental mapping tool, NJ-GeoWeb. Wetland maps reflecting the NWI and NJ-GeoWeb query results are included as Figures 1 and 2, respectively.

Given that all or the majority of the wetlands mapped by the NWI and NJ-Geoweb are based on remotely sensed data and not ground verification, these wetlands may be approximate. The 2012-2013, 2019, and 2020 on-Site field efforts were conducted to yield the most accurate boundaries and characterizations of the wetland systems present. The culmination of these wetland characterization efforts is provided as Figure 3 of this technical memorandum.

2.1 Wetland Soils

The United States Department of Agriculture (USDA) National Soil Survey Handbook maps indicate that four soil types are represented at the Site, as indicated in Figure 4:

- Urban Land (UR)
- Haledon silt loam, 0-3 percent slopes, somewhat poorly drained (HanA)
- Psamments fine to coarse sand, 0-3 percent slopes, well drained (PssA)
- Psamments sulfidic substratum, fine sands to mucky peat, 0-3 percent slopes, moderately well drained (PstA)

Both Psamment soil types (PssA, PstA) and HanA soils are characterized as non-hydric, however PssA and PstA soil may include as much as 10 percent hydric inclusions.

Soils at the Site are primarily represented by the UR mapping unit (72 percent), consisting of land covered by pavement, concrete, buildings, and other structures underlain by both disturbed and natural soil material. PssA soils present within the entirety of LF1 and outlying areas (Figure 4). PstA soils are present within wetlands bordering the southeast periphery of the AOC 12 Detention Basin. Through subsurface investigations at the Site, soils were generally found to be sand to loamy sand, with higher concentrations of clay and/or silt in wetter areas.

Soil colors observed in the vast majority of the wetlands from across the Site were compared to the Munsell Soil Color Charts and ranged from 5YR to 7.5YR hues. Lower chroma soil colors and the presence of either organic streaking or redox features were observed in wetter areas such as saturated soils or ponded water. Hydric soils observed at the Site typically exhibited the following characteristics: 1) sandy silts and gravel with a depleted matrix and redox features throughout, or 2) brighter sandy silts and gravel in the upper 10 inches of the soil profile, with dark-grey organic streaking in the lower 10 inches of soil.

Wetland soils in the AOC 12 Detention Basin from soil profiling conducted along the northcentral perimeter of the basin consisted predominantly of sandy clay with minimal mottling and organic inclusions down to 18-inches. The surficial (0-1 inch) horizon was composed of sandy silt and muck, and included fibrous vegetative matter.

Soil profiling was also conducted in the northern portion of the North Drainage Ditch (Arthur Kill tributary). Three distinct soil horizons were observed. The surficial (0-0.5 inches) horizon consisted of a low chroma silt with depleted matrix and redox features, with fibrous vegetative matter. Soils from 0.5-8 inches were a low chroma silty clay loam with 5 percent mottling throughout and fibrous vegetative matter. From 8-18 inches, soils were saturated and dominated by a low chroma silt matrix.

2.2 Hydrology

Outside of open water areas, evidence of hydrology was generally observed in depressional areas and in drainage patterns and microtopographic relief. In these areas, investigation showed that soils were generally saturated at approximately 12 inches below ground surface (bgs). A shallow water table was encountered at approximately 12 to 16 inches bgs at most locations. Typically, the sections of the site where these signs of hydrology were present also corresponded to the presence of hydrophytic vegetation and or hydric soils. Open water features at the Site consist of the following:

- Arthur Kill – a large SE2 (saline) navigable, tidal waterway located along the eastern Site boundary
- AOC 12 Detention Pond – a man-made stormwater retention structure that receives stormwater from various areas of the Site and has become naturalized over time
- AOC 12 Head Pond – small pond along the southwestern border of the Site that receives surface water from the detention basin and is also influenced by Smith Creek, a tidal flowing watercourse that connects with the Arthur Kill to the southwest
- North Drainage Ditch – a tidally influenced network of drainage ditches located on the northern portion of the Site that is hydrologically connected to the Arthur Kill.

Several wetland hydrology indicators were observed in the AOC 12 Detention Basin wetlands. Standing water was present at varying depths, up to 10 inches deep. Soils were saturated at approximately 4 inches bgs and drainage patterns were common throughout the herbaceous layer and surficial soils. Water marks were observed on invasive common reed (*Phragmites australis*) plants, and water-stained leaves were commonly visible on the ground surface within the Detention Basin wetlands.

In the northern portion of the North Drainage Ditch (Arthur Kill tributary), soils were saturated at approximately 8 inches bgs. Water flow and depth within the North Drainage Ditch are tidally influenced by the Arthur Kill. During the February 2020 wetland delineation effort, surface waters were observed in the ditch at a depth of approximately 8 inches. Water-stained leaves were commonly observed along the ground surface and along the ditch as well. A shallow water table and saturated surficial soils are expected to be common throughout the length of the North Drainage Ditch, particularly within wetlands fringing the ditch.

2.3 Vegetative Communities

As described in Section 2.1, land cover is predominantly Urban Land, generally consisting of impervious surfaces, crushed stone, engineered fill, or other anthropogenic cover material. In areas where vegetation is present, the vegetative communities represent the following habitat types: old field; scrub-shrub; *Phragmites*-dominated wetlands, freshwater wetlands; or saline marsh. These habitats are characteristic of a typical coastal community found in the Piedmont Region of New Jersey.

Wetland vegetative communities present at the Site are described in further detail in Section 2.4 of this memorandum.

2.4 Wetland Vegetative Communities

Phragmites-Dominated Wetlands – The depressional areas surrounding the North Drainage Ditch, the banks of the ditch, and the areas surrounding the AOC 12 Detention Basin consisted of a dense stand of *Phragmites*. The vegetative communities in these wetlands were largely a monoculture of invasive *Phragmites* plants, however other observed species included grey birch (*Betula populifolia*), eastern cottonwood (*Populus deltoides*), northern bayberry (*Morella pensylvanica*), wax myrtle (*Morella cerifera*), sedges (*Carex* spp.) and switchgrass (*Panicum virgatum*).

Freshwater Wetlands – In wetlands not dominated by *Phragmites*, such as the detention basin immediately south of LF1, a vegetative community comprised of native species is present. The detention basin located south of LF1 was comprised largely of a monoculture of spike rush (*Eleocharis palustris*). However, other native species were observed growing atop the outer banks of this depressional area. These native species included black willow (*Salix nigra*), eastern cottonwood, northern bayberry, groundsel bush (*Baccharis halimifolia*), woolgrass (*Scirpus cyperinus*), switchgrass, soft rush (*Juncus effusus*), and broadleaf cattail (*Typha latifolia*).

Saline Marsh – Along the eastern boundary of the Site, the vegetative community is comprised of a smooth cordgrass (*Spartina alterniflora*), a common salt marsh species found within this region of New Jersey. Within the marsh area itself, the vegetation is composed of a monoculture of smooth cordgrass. In the higher elevation areas surrounding the saline marsh, the vegetative community becomes dominated by *Phragmites*, which is not salt-tolerant. Other species observed in areas of higher elevation include marsh elder (*Iva annua*), switchgrass, and little bluestem (*Schizachyrium scoparium*). Expansive areas of exposed beach are also present within the interior portion of the marsh.

2.5 Wildlife Communities

Wildlife communities present at the Site consist of species typically observed in coastal wetlands or scrub-shrub habitat within the Coastal Plain Region of New Jersey. Additionally, the Site is located within the avian Mid-Atlantic flyway and is likely utilized as a stop-over site during both spring and fall migration periods. Species likely to be observed within this ecological setting include at the Site include the following: white-tailed deer (*Odocoileus virginianus*), groundhog (*Marmota monax*), raccoon (*Procyon lotor*), mice (Muridae), moles (Talpidae), northern short-tailed shrew (*Blarina brevicauda*), red-tailed hawk (*Buteo jamaicensis*), eastern screech owl (*Megascops asio*), passerines (those typically found within the coastal region), common garter snake (*Thamnophis sirtalis*), eastern rat snake (*Pantherophis alleghaniensis*), and northern green frog (*Lithobates clamitans melanota*).

Wildlife observed utilizing the inundated and emergent fringe wetland habitat within and along the periphery of the AOC 12 Detention Basin during ecological reconnaissance in June 2019 included mute swan (*Cygnus olor*), red-winged blackbird (*Agelaius phoeniceus*), northern green frog, song sparrow (*Melospiza melodia*), and yellow warbler (*Setophaga petechia*). Canada geese (*Branta canadensis*), ducks, and wading birds such as herons likely utilize the basin habitats for foraging and potentially nesting.

2.6 Threatened and Endangered Species

A review of the New Jersey Natural Heritage Database (NHD) search results (Attachment C) and the NJDEP Landscape v3.3 Viewer (NJDEP Division of Fish and Wildlife 2019) indicates that the majority of vegetated areas at the Site have been assigned Conservation Rank 1 by the NJDEP for the presence of suitable habitat for Threatened and Endangered (T&E) species or Special Concern (SC) species. The tidally influenced section of the North Drainage Ditch is assigned Conservation Rank 5 by the NJDEP for the recorded occurrence of shortnose sturgeon (*Acipenser brevirostrum*), a Federal and State Listed Endangered species; black-crowned night-heron (*Nycticorax nycticorax*), a NJ State Threatened species; and little blue heron (*Egretta caerulea*), glossy ibis (*Plegadis falcinellus*), and snowy egret (*Egretta thula*), all NJ State SC species.

The AOC 12 Detention Pond has been assigned Conservation Rank 3 by the NJDEP for the recorded occurrences of black-crowned night-heron, a NJ State Threatened species; and little blue heron, glossy ibis, and snowy egret, all NJ State SC species.

Though not identified within the Site bounds, the following T&E and SC species have recorded occurrences near the Site: peregrine falcon (*Falco peregrinus*) and pied-billed grebe (*Podilymbus podiceps*), both Conservation Rank 4 NJ State Endangered species; cattle egret (*Bubulcus ibis*), osprey (*Pandion haliaetus*), and yellow-crowned night-heron (*Nyctanassa violacea*), all Conservation Rank 3 NJ State Threatened species; and tricolored heron (*Egretta tricolor*), a Conservation Rank 2 NJ State SC species.

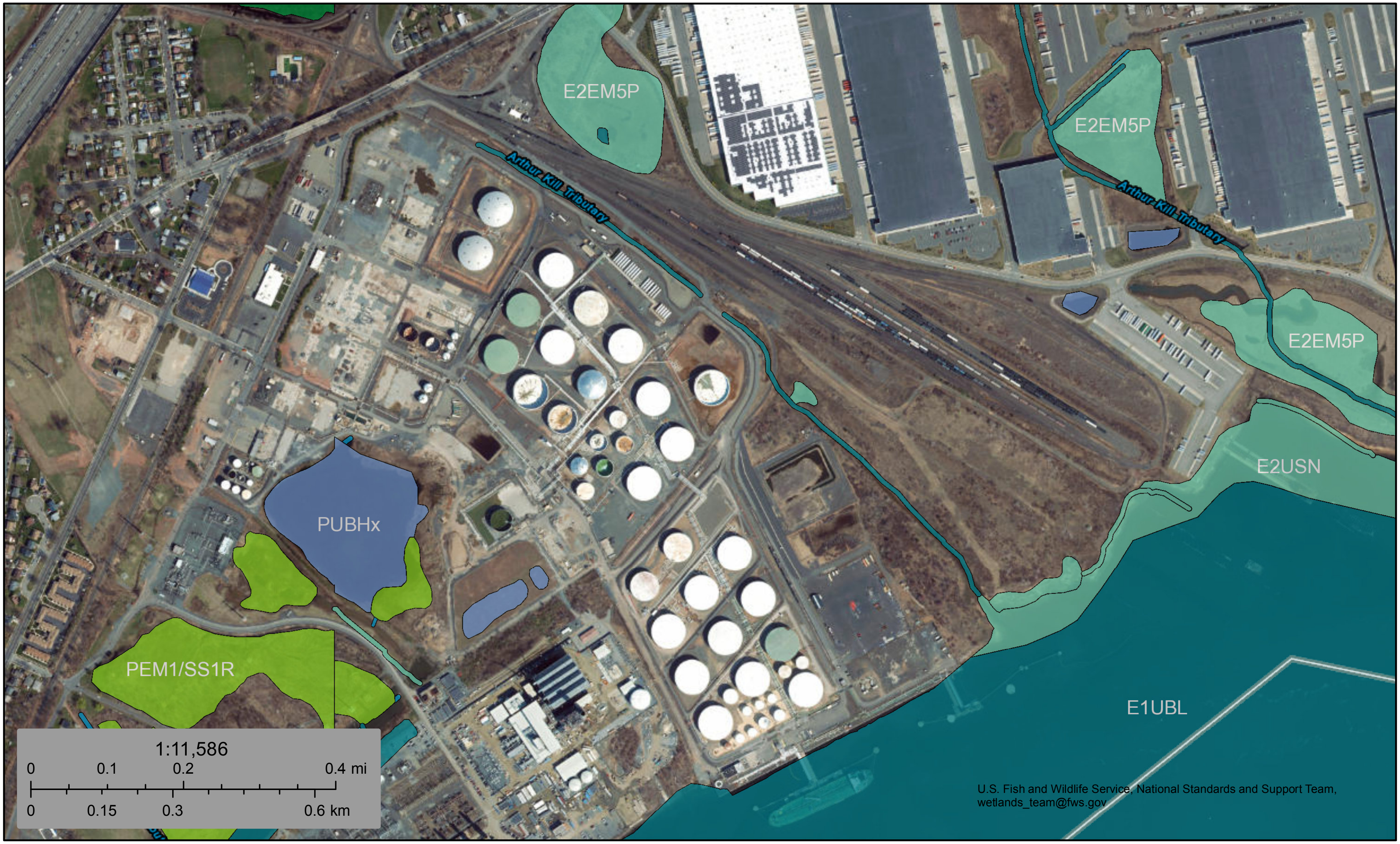
3 Summary

There are three distinct wetland communities located at the Site: 1) *Phragmites*-dominated wetlands; 2) freshwater wetlands; and 3) saline marsh. Wetland communities at the Site are comprised of stormwater detention ponds/basins, drainage ditches, and depressional areas along the North Drainage Ditch. The majority of these wetland systems are freshwater and possess hydrophytic vegetation communities and wildlife communities that reflect these freshwater resources. Freshwater wetland features are dominated by common reed (*Phragmites*), which may limit the ecological functionality and value of wetlands infested with this invasive plant species. The vegetative community present along the northeastern Site boundary and abutting the Arthur Kill consists of coastal saline marsh and is dominated by smooth cordgrass, a common emergent salt marsh species. The majority of the vegetated wetlands have been identified by the NJDEP as suitable habitat for T&E and/or SC species. The tidally influenced portion of the North Drainage Ditch and the AOC 12 ponds have documented occurrences of both NJ T&E species and NJ SC species, as identified by NHD and the NJDEP's Landscape Project.

FIGURES

U.S. Fish and Wildlife Service
National Wetlands Inventory

Figure 1. National Wetlands Inventory Map
Hess Corporation - Former Port Reading Complex



Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

RAMBOLL

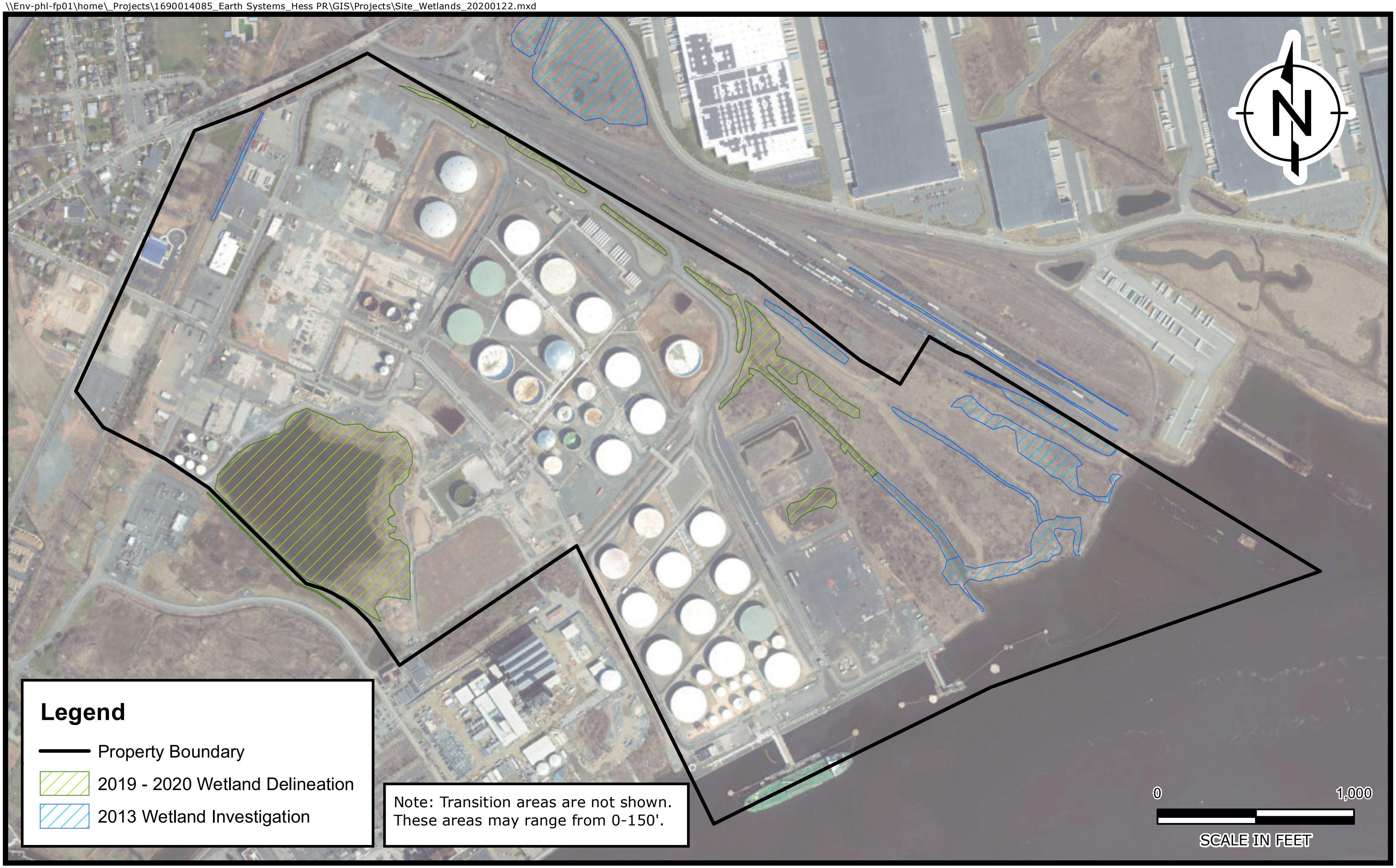
DRAFTED BY: DMR | DATE: 12/02/2020

NJDEP GeoWeb Wetlands (2012)
HESS CORPORATION - FORMER PORT READING COMPLEX
PORT READING, NEW JERSEY

FIGURE
2

PROJECT: 1940072854

\\Env-phl-fp01\home_Projects\1690014085_Earth Systems_Hess PR\GIS\Projects\Site_Wetlands_20200122.mxd



RAMBOLL

SITE WETLANDS

HESS CORPORATION - FORMER PORT READING COMPLEX
PORT READING, NEW JERSEY

FIGURE 3

DRAFTED BY: SKI | DATE: 2/28/2020 | PROJECT: 1940072854

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RAMBOLL

NRCS SOIL SURVEY
HESS CORPORTATION - FORMER PORT READING COMPLEX
PORT READING, NEW JERSEY

FIGURE
4

DRAFTED BY: SKI | DATE: 1/3/2020 | PROJECT: 1940072854

ATTACHMENT A
WETLAND DETERMINATION DATA FORMS

2012 WETLAND DETERMINATION DATA FORMS

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 1

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.561123 Long: -74.240008 Datum: NAD 83

Soil Map Unit Name: PssA NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No	**Is the Sampled Area within a Wetland?** **Yes** ☑ **No**
Hydric Soil Present?	Yes ☑ No	
Wetland Hydrology Present?	Yes ☑ No	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres on Living Roots (C3)
- ☑ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☑ No ☐ Depth (inches): 5

Saturation Present? (includes capillary fringe) Yes ☑ No ☐ Depth (inches): 0

Wetland Hydrology Present? Yes ☑ **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: DP 1

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 ft)			
1. Populus deltoids	5	yes	FAC
2. Salix nigra	15	yes	OBL
3. Morella Pensylvanica	5	yes	FAC
4.			
5.			
6.			
7.			
	25 = Total Cover		

Herb Stratum (Plot size: 5 ft)			
1. Panicum vergatum	20		FAC
2. Eleocharis palustris	30	yes	OBL
3. Scirpus cyperinus	2		OBL
4. Unknown Grass	60	yes	
5. Schizachyrium scoparium	15		FACU
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	127 = Total Cover		

Woody Vine Stratum (Plot size:)			
1. None			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ✓ **No**

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-6	7.5 YR 5/4	90	7.5 YR 6/8	10	C	M	Sand	Gravel and cobble stone
6-10	7.5 YR 4/2	90	7.5 YR 5/8	10	C	M	Sand	Gravel and cobble stone

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? **Yes** ☑ **No** ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 2

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.560859 Long: -74.240795 Datum: NAD 83

Soil Map Unit Name: PssA NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** **Yes** ☐ **No** ☑
Hydric Soil Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☐ No ☑ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches):

Wetland Hydrology Present? Yes ☐ **No** ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP 2

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Betula populifolia	20		FAC
2. Morella Pensylvanica	60	yes	FAC
3.			
4.			
5.			
6.			
7.			
	80 = Total Cover		

Herb Stratum (Plot size: 5 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Panicum vergatum	75	yes	FAC
2. Daucus carota	5		UPL
3. Solidago rugosa	5		FAC
4. Morella Pensylvanica	5		FAC
5. Schizachyrium scoparium	20		FACU
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	110 = Total Cover		

Woody Vine Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☑ **No** ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12	7.5 YR 4/4	90	NA				Clay/Sand	Gravel and cobble stones
0-12	7.5 YR 3/2	10	NA		C		Clay/Sand	Gravel and cobble stones
12+	Refusal							

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ **No** ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 3

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.563042 Long: -74.240705 Datum: NAD 83

Soil Map Unit Name: UR NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No	**Is the Sampled Area within a Wetland?** **Yes** ☑ **No**
Hydric Soil Present?	Yes ☑ No	
Wetland Hydrology Present?	Yes ☑ No	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☑ Hydrogen Sulfide Odor (C1)
- ☑ Oxidized Rhizospheres on Living Roots (C3)
- ☑ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ☑	No ☐	Depth (inches): 0.5
Water Table Present?	Yes ☑	No ☐	Depth (inches): 0
Saturation Present? (includes capillary fringe)	Yes ☑	No ☐	Depth (inches): 0

Wetland Hydrology Present? Yes ☑ **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP3

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Iva annua	40	Yes	FACW
2. Morella cerifera	5		FAC
3.			
4.			
5.			
6.			
7.			
	45 = Total Cover		

Herb Stratum (Plot size: 5 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Phragmites australis	75	yes	FACW
2. Spartina alterniflora	25		OBL
3. Carex spp.	50	yes	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	150 = Total Cover		

Woody Vine Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ✓ No

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-6	7.5 YR 4/2	85	7.5 YR 4/6	15	C	M	Clay/Sand	Gravel
6-13	7.5 YR 4/1	80	7.5 YR 5/6	20	C	M	Clay/Sand	Gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ________

Depth (inches): ________

Hydric Soil Present? Yes ☑ **No** ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 4

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range:

Landform (hillslope, terrace, etc.): Berm Local relief (concave, convex, none): Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.562756 Long: -74.240582 Datum: NAD 83

Soil Map Unit Name: UR NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑	No ☐
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? **Yes** ☐ **No** ☑

If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☐	No ☑	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches):

Wetland Hydrology Present? Yes ☐ **No** ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP4

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Morella cerifera	60	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	60 = Total Cover		

Herb Stratum (Plot size: 5 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Panicum vergatum	30	Yes	FAC
2. Phragmites australis	40	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	70 = Total Cover		

Woody Vine Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☑ **No** ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16	7.5 YR 3/4	100	NA				Gravel/Sand	Gravel (Clay)

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.
[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ **No** ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 5

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range: ______

Landform (hillslope, terrace, etc.): Swale Local relief (concave, convex, none): ______ Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.562091 Long: -74.237939 Datum: NAD 83

Soil Map Unit Name: UR NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No	**Is the Sampled Area within a Wetland?** **Yes** ☑ **No**
Hydric Soil Present?	Yes ☑ No	
Wetland Hydrology Present?	Yes ☑ No	If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☑ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☑	No ☐	Depth (inches): 8
Saturation Present? (includes capillary fringe)	Yes ☑	No ☐	Depth (inches): 0

Wetland Hydrology Present? Yes ☐ **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP5

Tree Stratum (Plot size: ________)	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus deltoides	20	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	20 = Total Cover		
Sapling/Shrub Stratum (Plot size: ________)			
1. Morella Pensylvanica	40	Yes	FAC
2. Morella cerifera	30	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	70 = Total Cover		
Herb Stratum (Plot size: ________)			
1. Phragmites australis	50	Yes	FACW
2. Juncus effusus	50	Yes	OBL
3. Panicum vergatum	40	Yes	FAC
4. Astter spp.	5		
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	145 = Total Cover		
Woody Vine Stratum (Plot size: ________)			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☑ No

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12	7.5 YR 4/2	90	7.5 YR 5/8	10	C	M	Clay/Sand	Gravel and cobble stones
12+								Refusal on Cobbles

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ☑ **No** ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 6

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range: ______

Landform (hillslope, terrace, etc.): W Slwale Local relief (concave, convex, none): ______ Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.561949 Long: -74.237922 Datum: NAD 83

Soil Map Unit Name: UR NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑	No ☐	**Is the Sampled Area within a Wetland?** **Yes** ☐ **No** ☑
Hydric Soil Present?	Yes ☐	No ☑	
Wetland Hydrology Present?	Yes ☐	No ☑	If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☐	No ☑	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ☐	No ☑	Depth (inches):

Wetland Hydrology Present? Yes ☐ **No** ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP6

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft)			
1. 15 ftBetula populifolia	10	Yes	FAC
2. Morella pensylvanica	10	Yes	FAC
3. Morella cerifera	30	Yes	FAC
4.			
5.			
6.			
7.			
	50 = Total Cover		
Herb Stratum (Plot size: 5 ft)			
1. Schizachyrium scoparium	15		FACU
2. Panicum vergatum	40	Yes	FAC
3. Ambrosia spp.	40	Yes	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	95 = Total Cover		
Woody Vine Stratum (Plot size:)			
1. None			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☑ No ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL Sampling Point: DP6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-11	7.5 YR 3/4	100	NA				Silty, Sand	Gravel and cobble stones
11+								Refusal on Cobbles

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ **No** ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 7

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.56221 Long: -74.236924 Datum: NAD 83

Soil Map Unit Name: UR NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ☑ No
Hydric Soil Present? Yes ☑ No
Wetland Hydrology Present? Yes ☑ No

Is the Sampled Area within a Wetland? **Yes** ☑ **No**

If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☑ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ☑ No ☐ Depth (inches): 0

Wetland Hydrology Present? Yes ☑ **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP7

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Morella pensylvanica	20	Yes	FAC
2. Morella cerifera	10	Yes	FAC
3.			
4.			
5.			
6.			
7.			
	30 = Total Cover		

Herb Stratum (Plot size: 5 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Phragmites australis	20		FACW
2. Panicum vergatum	70	Yes	FAC
3. unknown Grass	30	Yes	
4. Ambrosia spp.	15		
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	135 = Total Cover		

Woody Vine Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☑ **No**

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-4	7.5 YR 3/1	100	NA				Clay/Sand	Gravel
4-12	7.5 YR 3/1	90	7.5 YR 4/6	10	C	M	Clay/Sand	
12+								Refusal

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☑ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** ☑ **No** ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 8

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.562061 Long: -74.236991 Datum: NAD 83

Soil Map Unit Name: UR NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑	No ☐
Hydric Soil Present?	Yes ☐	No ☑
Wetland Hydrology Present?	Yes ☐	No ☑

Is the Sampled Area within a Wetland? **Yes** ☐ **No** ☑

If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ☐	No ☑	Depth (inches):
Water Table Present?	Yes ☐	No ☑	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ☑	No ☐	Depth (inches): 14

Wetland Hydrology Present? Yes ☐ **No** ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP8

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: 15 Ft.)			
1. Morella cerifera	15	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	15	= Total Cover	
Herb Stratum (Plot size: 5 Ft.)			
1. Panicum vergatum	15		FAC
2. Ambrosia trifoda	70	Yes	FAC
3. Unknown Grass	40	Yes	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	125	= Total Cover	
Woody Vine Stratum (Plot size:)			
1. None			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 67 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☑ No ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-10	5 YR 4/4	100	NA				Clay/Sand	Gravel
10-12	5 YR 4/4	50	NA				Clay/Sand	
10-12	5 YR 3/1	50	NA				Clay/Sand	
12-15	2.5 YR 4/6	100	NA				Silty/Clay	Weathered Bed Rock/ Gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ☐ **No** ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 9

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range:

Landform (hillslope, terrace, etc.): Local relief (concave, convex, none): Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.560824 Long: -74.235235 Datum: NAD 83

Soil Map Unit Name: UR NWI classification:

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No	**Is the Sampled Area within a Wetland?** **Yes** ☑ **No**
Hydric Soil Present?	Yes ☑ No	
Wetland Hydrology Present?	Yes ☑ No	If yes, optional Wetland Site ID:

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☑ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☑ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☑ No ☐ Depth (inches): 1

Saturation Present? (includes capillary fringe) Yes ☑ No ☐ Depth (inches): 0

Wetland Hydrology Present? Yes ☑ **No**

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: DP9

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft)			
1. Iva annua	20	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
	20 = Total Cover		
Herb Stratum (Plot size: 5 ft)			
1. Phragmites australis	90	Yes	FACW
2. Unknown Herb	10		
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		
Woody Vine Stratum (Plot size:)			
1. None			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☑ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ☑ No

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3	10 YR 3/1	100	NA				Silty / Clay	Gravel
3-14	Gley2 2.5/10G	100	NA					80% Organic

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☑ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____

Depth (inches): ____

Hydric Soil Present? **Yes** ☑ **No** ☐

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 10

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range: ______

Landform (hillslope, terrace, etc.): ______ Local relief (concave, convex, none): ______ Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.560919 Long: -74.235031 Datum: NAD 83

Soil Map Unit Name: UR NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑	No ☐	**Is the Sampled Area within a Wetland?**	**Yes** ☐ **No** ☑
Hydric Soil Present?	Yes ☐	No ☑		
Wetland Hydrology Present?	Yes ☐	No ☑	If yes, optional Wetland Site ID: ______	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☐ No ☑ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches):

Wetland Hydrology Present? Yes ☐ **No** ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP10

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft.)			
1. Morella pensylvanica	20	Yes	FAC
2. Morella cerifera	20	Yes	FAC
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
Herb Stratum (Plot size: 5 ft.)			
1. Panicum vergatum	85	Yes	FAC
2. Phragmites australis	3		FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	88	= Total Cover	
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☐ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☑ **No** ☐

Remarks: (Include photo numbers here or on a separate sheet.)

Bare Ground / Gravel 30 %

SOIL

Sampling Point: DP10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12	10 YR 2/2	100	NA				Gravely, Sand	
12+								Refusal on Gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ☐ **No** ☑

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Hess City/County: Port Reading/Middlesex Sampling Date: 12/07/2012

Applicant/Owner: Hess State: NJ Sampling Point: DP 11

Investigator(s): Taryn Correll, Thomas Newcomb Section, Township, Range: ______

Landform (hillslope, terrace, etc.): ______ Local relief (concave, convex, none): ______ Slope (%): 0%

Subregion (LRR or MLRA): LRR Lat: 40.562164 Long: -74.239264 Datum: NAD 83

Soil Map Unit Name: UR NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ (If no, explain in Remarks.)

Are Vegetation No, Soil No, or Hydrology No significantly disturbed? Are "Normal Circumstances" present? Yes ☑ No ☐

Are Vegetation No, Soil No, or Hydrology No naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☐ No ☑
Hydric Soil Present?	Yes ☐ No ☑	
Wetland Hydrology Present?	Yes ☐ No ☑	If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ Marl Deposits (B15)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry-Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):

Water Table Present? Yes ☐ No ☑ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches):

Wetland Hydrology Present? Yes ☐ **No** ☑

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP11

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Morella pensylvanica	25	Yes	FAC
2. Morella cerifera	40	Yes	FAC
3. Betula populifolia	30	Yes	FAC
4.			
5.			
6.			
7.			
	95 = Total Cover		

Herb Stratum (Plot size: 5 ft)	Absolute % Cover	Dominant Species?	Indicator Status
1. Panicum vergatum	50	Yes	FAC
2. Phragmites australis	5	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	55 = Total Cover		

Woody Vine Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1. Nine			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ☑ **No** ☐

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP11

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	7.5 YR 4/4	100	NA					
8-12	7.5 YR 4/3	95	7.5 YR 4/6	5	M	C	Silty, Clay	Little Gravel
12+	7.5 YR 4/2	80	7.5 YR 7/8	20	M	C	Silty, Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ☐ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ☐ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ☐ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ☐ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ☐ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ☐ Dark Surface (S7) (**LRR K, L, M**)
- ☐ Polyvalue Below Surface (S8) (**LRR K, L**)
- ☐ Thin Dark Surface (S9) (**LRR K, L**)
- ☐ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ☐ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ☐ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ☐ Red Parent Material (F21)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ☐ No ☑

Remarks:

2019 WETLAND DETERMINATION DATA FORMS

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-01

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): Top of hillslope Local relief (concave, convex, none): none

Slope (%): 4-5% Lat: 629483.0626 Long: 564350.3875 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___
Hydric Soil Present?	Yes ___	No X
Wetland Hydrology Present?	Yes ___	No X

Is the Sampled Area within a Wetland? **Yes** ___ **No** X

If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Soil was very dry at the time of the site investigation.

VEGETATION – Use scientific names of plants.

Sampling Point: DP-01

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Populus deltoides	3%	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	3% = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1. Myrica pensylvanica	5%	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	5% = Total Cover		

Herb Stratum (Plot size: 5')	Absolute % Cover	Dominant Species?	Indicator Status
1. Eupatorium perfoliatum	10%	No	FACW
2. Panicum virgatum	35%	Yes	FAC
3. Solidago rugosa	10%	No	FAC
4. Baccharis halimifolia	15%	Yes	FACW
5. Polygonum perfoliatum	5%	No	FAC
6. Perilla frutescens	3%	No	FAC
7. Pseudognaphalium obtusifolium	7%	No	NL
8.			
9.			
10.			
11.			
12.			
	85% = Total Cover		

Woody Vine Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0%	x 1 =	0
FACW species	25%	x 2 =	50
FAC species	61%	x 3 =	183
FACU species	0%	x 4 =	0
UPL species	7%	x 5 =	35
Column Totals:	93% (A)		268 (B)

Prevalence Index = B/A = 2.88

Hydrophytic Vegetation Indicators:

- X Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- X Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No ___

Remarks: (Include photo numbers here or on a separate sheet.)

The surrounding landscape is largely comprised of a facultative vegetative community, so compared to wetland data points there are much fewer FACW and OBL vegetative species present.

SOIL

Sampling Point: DP-01

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12"	7.5YR 3/4	100					SAND	Gravel/Cobbles throughout, dry

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ______ No X

Remarks:

Encountered refusal around 12" BGS due to the presence of large cobbles/gravel.

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-02

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): Depressional Area Local relief (concave, convex, none): Concave

Slope (%): 0-1% Lat: 629456.0246 Long: 564365.5749 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	If yes, optional Wetland Site ID: WB01

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
X Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___ No X	Depth (inches): ___	
Water Table Present?	Yes ___ No X	Depth (inches): ___	
Saturation Present? (includes capillary fringe)	Yes X No ___	Depth (inches): 12"	**Wetland Hydrology Present? Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP-02

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
Herb Stratum (Plot size: 5')			
1. Eleocharis palustris	99%	Yes	OBL
2. Polygonum spp.	1%	No	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100%	= Total Cover	
Woody Vine Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	99	x 1 =	99
FACW species	1	x 2 =	2
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	100 (A)		102 (B)

Prevalence Index = B/A = 1.02

Hydrophytic Vegetation Indicators:

X Rapid Test for Hydrophytic Vegetation

X Dominance Test is >50%

X Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-02

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-1"	Organic Layer							Root Mat
1-4"	5YR 3/3	100%					Sandy Silt	Root mat throughout, wet
4-10"	5YR 3/3	100%					Sandy Silt	Large gravel/cobbles throughout
10-18"	5YR 3/3	85%	10YR 3/1	15%			Sandy Silt	Saturated, dark-grey streaking

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes X **No** ______

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-03

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): ______ Local relief (concave, convex, none): none

Slope (%): 1-2% Lat: 629870.926 Long: 564420.2677 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No X
Hydric Soil Present?	Yes ___	No X
Wetland Hydrology Present?	Yes ___	No X

Is the Sampled Area within a Wetland? **Yes** ___ **No** X

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants. Sampling Point: DP-03

Tree Stratum (Plot size: 30')

	Absolute % Cover	Dominant Species?	Indicator Status
1. Juniperus virginiana	5%	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover	5%		

Sapling/Shrub Stratum (Plot size: 15')

	Absolute % Cover	Dominant Species?	Indicator Status
1. Betula populifolia	15%	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
= Total Cover	15%		

Herb Stratum (Plot size: 5')

	Absolute % Cover	Dominant Species?	Indicator Status
1. Schizachyrium scoparium	30%	Yes	FACU
2. Pseudognaphalium obtusifolium	15%	No	NL
3. Salidago spp.	10%	No	FAC
4. Panicum virgatum	20%	Yes	FAC
5. Melilotus officinalis	5%	No	FACU
6. Artemisia vulgaris	12%	No	UPL
7.			
8.			
9.			
10.			
11.			
12.			
= Total Cover	92%		

Woody Vine Stratum (Plot size: 15')

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
= Total Cover			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0%	x 1 =	0
FACW species	0%	x 2 =	0
FAC species	45%	x 3 =	135
FACU species	40%	x 4 =	160
UPL species	27%	x 5 =	135
Column Totals:	112% (A)		430 (B)

Prevalence Index = B/A = 3.84

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-03

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3"	7.5 YR 5/3	100					SAND	Large Cobbles, very dry
3-18"	7.5 YR 4/6	100					SAND	Dry, Cobbles throughout

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ______ No X

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-04

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave

Slope (%): 1-2% Lat: 629911.652 Long: 564461.3677 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ___ Hydric Soil Present? Yes X No ___ Wetland Hydrology Present? Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___ If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
X Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- X Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___

Water Table Present? Yes ___ No X Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 12"

Wetland Hydrology Present? Yes X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Though soil exhibited a lighter chroma, signs of hydrology would likely be present during wetter conditions.

VEGETATION – Use scientific names of plants.

Sampling Point: DP-04

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1. Betula populifolia	15%	Yes	FAC
2. Baccharis halimifolia	10%	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	25% = Total Cover		
Herb Stratum (Plot size: 5')			
1. Phragmites australis	100%	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100% = Total Cover		
Woody Vine Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- X Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes X No ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-04

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-16"	5YR 4/3	100					Clay	Dry (Moist at 12")
16"-18"	5YR 3/3	85%	10YR 3/1	15%			Sandy Silt	Saturated, dark-grey streaking

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes X **No** ______

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-05

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): ______ Local relief (concave, convex, none): ______

Slope (%): 3% Lat: 630195.4027 Long: 564175.2354 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___	**Is the Sampled Area within a Wetland?** **Yes** ___ **No** X
Hydric Soil Present?	Yes ___	No X	
Wetland Hydrology Present?	Yes ___	No X	If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ______
Water Table Present?	Yes ___	No X	Depth (inches): ______
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ______

Wetland Hydrology Present? Yes ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP-05

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1. Baccharis halimifolia	3%	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
	3% = Total Cover		

Herb Stratum (Plot size: 5')	Absolute % Cover	Dominant Species?	Indicator Status
1. Panicum virgatum	80%	Yes	FAC
2. Baccharis halimifolia	5%	No	FACW
3. Salidago spp.	15%	No	FAC
4. Pseudognaphalium obtusifolium	20%	No	NL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	125% = Total Cover		

Woody Vine Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- X Rapid Test for Hydrophytic Vegetation
- X Dominance Test is >50%
- __ Prevalence Index is ≤3.0[1]
- __ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- __ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-05

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3"	7.5 YR 5/3	100					SAND	Large, Cobbles, very dy
3-18"	7.5 YR 4/6	100					SAND	Dry, Cobbles throughout

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ___ No _X_

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-06

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): ______ Local relief (concave, convex, none): concave

Slope (%): 0-2% Lat: 630217.6988 Long: 564120.1355 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No ___
Hydric Soil Present?	Yes ___	No ___
Wetland Hydrology Present?	Yes ___	No ___

Is the Sampled Area within a Wetland? **Yes** ___ **No** ___

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- X Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- X Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes X	No ___	Depth (inches): 12"
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 3"

Wetland Hydrology Present? Yes X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP-06

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	= Total Cover		

Sapling/Shrub Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1. Morella pensylvanica	5%	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	5% = Total Cover		

Herb Stratum (Plot size: 5')	Absolute % Cover	Dominant Species?	Indicator Status
1. Phragmites australis	100%	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100% = Total Cover		

Woody Vine Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

X Rapid Test for Hydrophytic Vegetation

X Dominance Test is >50%

__ Prevalence Index is ≤3.0[1]

__ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-06

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-1"	Organic layer							Root Mat
1-4"	5YR 3/3	100%					Sandy Silt	Root mat throughout, wet
4-10"	5YR 3/3	100%					Sandy Silt	Large gravel/cobbles throughout
10-12"	5YR 3/3	85%	10YR 3/1	15%			Sandy Silt	Saturated, dark-grey streaking
12-18"	7.5YR 2.5/1	100%					SAND	Saturated, gravel, organics, silt

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes X **No** ______

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-07

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): Side of Slope Local relief (concave, convex, none): concave

Slope (%): 5% Lat: 630105.1513 Long: 564036.279 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- X Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- X Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___	
Water Table Present?	Yes X	No ___	Depth (inches): 16"	
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 10"	**Wetland Hydrology Present? Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP-07

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	
Herb Stratum (Plot size: 5')			
1. Phragmites australis	100%	Yes	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100%	= Total Cover	
Woody Vine Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

X Rapid Test for Hydrophytic Vegetation

X Dominance Test is >50%

__ Prevalence Index is ≤3.0[1]

__ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** X **No** ____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-07

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-1"	Oganic Layer							Root Mat
1-4"	5YR 3/3	100%					Sandy Silt	Root mat throughout, wet
4-16"	5YR 3/3	100%					Sandy Silt	Large gravel/cobbles throughout
16-18"	5YR 3/3	85%	10YR 3/1	15%			Sandy Silt	Saturated, dark-grey streaking

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** X **No** ______

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Former Hess Port Reading Site City/County: Woodbridge/Middlesex Sampling Date: 9/26/2019

Applicant/Owner: Earth Systems State: NJ Sampling Point: DP-08

Investigator(s): Owen Zalme and Jay Shipley Section, Township, Range: Sewaren, Woodbridge Township

Landform (hillslope, terrace, etc.): ______ Local relief (concave, convex, none): ______

Slope (%): 1-2% Lat: 629955.6598 Long: 564153.0257 Datum: NJ State Plane

Soil Map Unit Name: PssA/UR NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No X	**Is the Sampled Area within a Wetland?** **Yes** ___ **No** X
Hydric Soil Present?	Yes ___	No X	
Wetland Hydrology Present?	Yes ___	No X	If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ______
Water Table Present?	Yes ___	No X	Depth (inches): ______
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ______

Wetland Hydrology Present? Yes ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: DP-08

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. Pyrus calleryana	5%	Yes	NL
2. Populus deltoides	8%	Yes	FAC
3. Betula populifolia	3%	No	FAC
4. Ailanthus altissima	4%	Yes	UPL
5.			
6.			
7.			
	20%	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1. Baccharis halimifolia	20%	Yes	FACW
2. Prunus serotina	5%	Yes	FACU
3.			
4.			
5.			
6.			
7.			
	25%	= Total Cover	

Herb Stratum (Plot size: 5')	Absolute % Cover	Dominant Species?	Indicator Status
1. Panicum virgatum	80%	Yes	FAC
2. Artemisia vulgaris	60%	Yes	UPL
3. Salidago spp.	10%	No	FAC
4. Pseudognaphalium obtusifolium	5%	No	NL
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	155%	= Total Cover	

Woody Vine Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	0%	x 1 = 0
FACW species	20%	x 2 = 40
FAC species	101%	x 3 = 303
FACU species	15%	x 4 = 60
UPL species	79%	x 5 = 395
Column Totals:	215% (A)	798 (B)

Prevalence Index = B/A = 3.71

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation
___ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: DP-08

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-3"	7.5 YR 5/3	100%					Sand	Large Cobbles, very dry
3-6"	7.5 YR 4/6	100%					Sand	Dry, Cobbles throughout

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________

Depth (inches): ______________

Hydric Soil Present? Yes ______ No ______

Remarks:

Soil refusal at 6"

2020 WETLAND DETERMINATION DATA FORMS

WETLAND DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Project/Site:	**Port Reading Terminal**	Date:	**2/5/2020**
Applicant/Owner:	**Earth Systems**	County:	**Middlesex County**
Investigator:	**Ramboll (Danielle Radomile and Amy Hirrlinger)**	State:	**New Jersey**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	-
Is the area a potential Disturbed Area	**Yes**	No	Transect ID:	-
Is the area a potential Problem Area?	Yes	**No**	Plot ID	**W1 (northern reach of Arthur Kill tributary)**

VEGETATION

Dominant Plant Species	Stratum	Regional Indicator	National Indicator	Dominant Plant Species	Stratum	Regional Indicator	National Indicator
1 Common Reed (Phragmites australis)	**Shrub**	**FACW**		8			
2 Common Reed (Phragmites australis)	**Herb**	**FACW**		9			
3				10			
4				11			
5				12			
6				13			
7				14			

Percent of Dominant Species that are OBL, FACW or FAC: **100%**

Remarks:
Dominated by phragmites; surrounds the water feature (Arthur Kill Tributary). Vegetation height varies from 1' to 9'.

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
____ Stream, Lake or Tide Gauge
__ _ __ Aerial Photographs
_____ Other
__X___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 8 (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: 8 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 inches
___ Water marks
___ Drift Lines
___ Sediment Deposits
X Drainage Patterns in Wetlands
Secondary Indicators (2 or more required):
___ Morphological Plant Adaptions
___ Oxidized Root Channels in Upper 12 in.
X Water-Stained Leaves
___ Local Soil Survey Data
___ FAC-Neutral Test
___ Other (Explain in Remarks)

Remarks:
Water stains observed on phragmites stems. Wet/decomposing leaves and roots. Some redox observed. Water feature (Arthur Kill Tributary) runs through center of wetland. Water feature varies in width from 1' to 7'. The water feature is a piped channel that discharges into the wetland

SOILS

Map Unit Name
(Series and Phase): **Urban Land**
Drainage Class: **Unknown**
Field Observations
Taxonomy (Subgroup): Unknown
Confirm Mapped Type? Yes **No**

Depth to Seasonal High Water Table: Unknown

Profile Description:

Depth (Inches)	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0 - 0.5	**2.5YR 3/2**	**2.5YR 4/6**	**40%**	**Plant fibers, smooth, silt**
0.5 - 8	**5Y 2.5/1**	**2.5YR 4/6**	**5%**	**Silty clay loam, plant fibers**
8 - 18	**5Y 2.5/1**	**-**		**Silty, slimy, saturated**

Hydric Soil Indicators:

	Histosol		Iron and Maganese Concretions
	Histic Epipedon		High Org. Content in Surf. Layer in Sandy Soils
	Sulfidic Odor		Organic Streaking in Sandy Soils
	Aquic Moisture Regime		Organic pan/wet spodosol
X	Reducing Conditions		Listed on Local or National Hydric Soils List
X	Gleyed or Low-Chroma Colors		Other (Explain in Remarks)

Remarks:
Organic matter observed on top-most layer and throughout the soil column

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No
Wetland Hydrology Present?	**Yes**	No
Hydric Soils Present?	**Yes**	No

Is this Sampling Point Within a Wetland? **Yes** No

Remarks:
Fringe wetland along Arthur Kill Tributary. Hugs the northern site boundary. Trash and debris present.

WETLAND DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Project/Site:	**Port Reading Terminal**	Date:	**2/5/2020**
Applicant/Owner:	**Earth Systems**	County:	**Middlesex County**
Investigator:	**Ramboll (Danielle Radomile and Amy Hirrlinger)**	State:	**New Jersey**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	-
Is the area a potential Disturbed Area	**Yes**	No	Transect ID:	-
Is the area a potential Problem Area?	Yes	**No**	Plot ID	**W2 (northern reach of Arthur Kill tributary)**

VEGETATION

Dominant Plant Species	Stratum	Regional Indicator	National Indicator	Dominant Plant Species	Stratum	Regional Indicator	National Indicator
1 Common Reed (Phragmites australis)	**Shrub**	**FACW**		8			
2 Common Reed (Phragmites australis)	**Herb**	**FACW**		9			
3				10			
4				11			
5				12			
6				13			
7				14			

Percent of Dominant Species that are OBL, FACW or FAC: **100%**

Remarks:
Dominated by phragmites; surrounds the water feature (Arthur Kill Tributary). Vegetation height varies from 1' to 9'.

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
____ Stream, Lake or Tide Gauge
___ Aerial Photographs
_____ Other
__X___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 8 (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: 8 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
- X Inundated
- X Saturated in Upper 12 inches
- ___ Water marks
- ___ Drift Lines
- ___ Sediment Deposits
- X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Morphological Plant Adaptions
- ___ Oxidized Root Channels in Upper 12 in.
- X Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- Other (Explain in Remarks)

Remarks:
Water stains observed on phragmites stems. Wet/decomposing leaves and roots. Some redox observed. Water feature (Arthur Kill Tributary) runs through center of wetland. Water feature varies in width from 1' to 7'. The water feature is a piped channel that discharges into the wetland

SOILS

Map Unit Name
(Series and Phase): **Urban Land**
Drainage Class: **Unknown**
Field Observations
Taxonomy (Subgroup): Unknown
Confirm Mapped Type? Yes **No**

Depth to Seasonal High Water Table: Unknown

Profile Description:

Depth (Inches)	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0 - 0.5	**2.5YR 3/2**	**2.5YR 4/6**	**40%**	**Plant fibers, smooth, silt**
0.5 - 8	**5Y 2.5/1**	**2.5YR 4/6**	**5%**	**Silty clay loam, plant fibers**
8 - 18	**5Y 2.5/1**	**-**		**Silty, slimy, saturated**

Hydric Soil Indicators:

	Histosol		Iron and Maganese Concretions
	Histic Epipedon		High Org. Content in Surf. Layer in Sandy Soils
	Sulfidic Odor		Organic Streaking in Sandy Soils
	Aquic Moisture Regime		Organic pan/wet spodosol
X	Reducing Conditions		Listed on Local or National Hydric Soils List
X	Gleyed or Low-Chroma Colors		Other (Explain in Remarks)

Remarks:
Organic matter observed on top-most layer and throughout the soil column

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	**Yes**	No	Is this Sampling Point Within a Wetland?
Wetland Hydrology Present?	**Yes**	No	**Yes** No
Hydric Soils Present?	**Yes**	No	

Remarks:
Fringe wetland along Arthur Kill Tributary. Hugs the northern site boundary. Trash and debris present.

WETLAND DATA FORM
ROUTINE ONSITE DETERMINATION METHOD

Project/Site:	**Port Reading Terminal**	Date:	**2/5/2020**
Applicant/Owner:	**Earth Systems**	County:	**Middlesex County**
Investigator:	**Ramboll (Danielle Radomile and Amy Hirrlinger)**	State:	**New Jersey**

Do Normal Circumstances exist on the site?	**Yes**	No	Community ID:	-
Is the area a potential Disturbed Area	**Yes**	No	Transect ID:	-
Is the area a potential Problem Area?	Yes	**No**	Plot ID	**W3/W3b (north Detention Basin)**

VEGETATION

Dominant Plant Species	Stratum	Regional Indicator	National Indicator	Dominant Plant Species	Stratum	Regional Indicator	National Indicator
1 Common Reed (Phragmites australis)	**Shrub**	**FACW**		8			
2 Common Reed (Phragmites australis)	**Herb**	**FACW**		9			
3				10			
4				11			
5				12			
6				13			
7				14			

Percent of Dominant Species that are OBL, FACW or FAC: **100%**

Remarks:
Dominated by phragmites; switchgrass was also present, but not considered a dominant species.

HYDROLOGY

_____ Recorded Data (Describe in Remarks):
____ Stream, Lake or Tide Gauge
_____ Aerial Photographs
_____ Other
__X___ No Recorded Data Available

Field Observations:

Depth of Surface Water: 0 - 10 (in.)
Depth of Free Water in Pit: - (in.)
Depth to Saturated Soil: 4 (in.)

Wetland Hydrology Indicators:
Primary Indicators:
X Inundated
X Saturated in Upper 12 inches
x Water marks
_____ Drift Lines
_____ Sediment Deposits
X Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
_____ Morphological Plant Adaptions
x Oxidized Root Channels in Upper 12 in.
X Water-Stained Leaves
_____ Local Soil Survey Data
_____ FAC-Neutral Test
Other (Explain in Remarks)

Remarks:
Access road that runs between southern fenceline/W3b and SW portion of W3 was inundated with water.

SOILS

Map Unit Name

(Series and Phase): PstA - Psamments sulfidic substratum 0 to 3 percent slopes

Drainage Class: **Moderately well drained**

Field Observations

Taxonomy (Subgroup): Unknown

Confirm Mapped Type? **Yes** No

Depth to Seasonal High Water Table: Unknown

Profile Description:

Depth (Inches)	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)		Mottle Abundance/ Size/Contrast	Texture, Concretions, Structure, etc.
0 -1	**5YR 2.5/2**				**Mucky. Sandy silt. Fibrous organic material**
1 -18	**2.5YR 4/4**	**2.5YR 6/6**	**3%**		**Sandy clay. Some organic material**

Hydric Soil Indicators:

	Histosol		Iron and Maganese Concretions
	Histic Epipedon		High Org. Content in Surf. Layer in Sandy Soils
	Sulfidic Odor		Organic Streaking in Sandy Soils
	Aquic Moisture Regime		Organic pan/wet spodosol
X	Reducing Conditions		Listed on Local or National Hydric Soils List
X	Gleyed or Low-Chroma Colors		Other (Explain in Remarks)

Remarks:

Evidence of fill and construction debris in several pockets throughout wetland (mostly present in southern portion of wetland.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? **Yes** No

Wetland Hydrology Present? **Yes** No

Hydric Soils Present? **Yes** No

Is this Sampling Point Within a Wetland? **Yes** No

Remarks:

Flags #1 and #60 do not connect.

Between flags #23 and #24, there is ~10' gap due to water inlet

Observed swans, ducks, geese, fish, and unidentified animal tracks, scat, and den

ATTACHMENT B
PHOTOGRAPHIC LOG

Photo 1: Confluence of the North Drainage Ditch tributary and Arthur Kill.

Photo 2: View of the North Drainage Ditch tributary and fringe wetlands located southeast of No. 1 Landfarm (LF1).

Photo 3: View of the North Drainage Ditch tributary and fringe wetlands located southeast of LF1.

Photo 4: View of the North Drainage Ditch tributary and fringe wetlands located southeast of LF1.

Photo 5: View of the North Drainage Ditch tributary and fringe wetlands located east of LF1.

Photo 6: View of the North Drainage Ditch tributary and fringe wetlands located east of LF1.

Photo 7: A soil boring collected from within wetland along the North Drainage Ditch tributary.

Photo 8: View of a culvert that connects the North Drainage Ditch features.

Photo 9: View of open water and common reed (*Phragmites australis*) dominated fringe wetlands along the AOC 12 Detention Basin.

Photo 10: View of open water and *Phragmites*-dominated fringe wetlands in AOC 12 Detention Basin.

Photo 11: View of open water and *Phragmites*-dominated fringe wetlands in AOC 12 Detention Basin.

Photo 12: View of inudundated access road and *Phragmites*-dominated wetlands located southwest of the AOC 12 Detention Basin.

Photo 13: View of saline marsh area adjacent to the Arthur Kill and north of the North Drainage Ditch.

Photo 14: View of saline marsh area adjacent to the Arthur Kill and north of the North Drainage Ditch.

RAMBOLL	**Site Photographs** Hess Corporation – Former Port Reading Complex 750 Cliff Road, Port Reading, NJ December 2020

Photo 15: View of saline marsh area adjacent to the Arthur Kill and north of the North Drainage Ditch.

Photo 16: View of saline marsh area adjacent to the Arthur Kill and south of the North Drainage Ditch.

Photo 17: View of LF1 wetland feature.

Photo 18: View of LF1 wetland feature.

Site Photographs
Hess Corporation – Former Port Reading Complex
750 Cliff Road, Port Reading, NJ
December 2020

Photo 19: View of wetland feature located south of LF1.

Photo 20: A soil boring collected from a wetland feature located south of LF1.

Photo 21: View of the North Landfarm (NLF) wetland feature adjoining bermed railroad track (abandoned).

ATTACHMENT C
NATURAL HERITAGE DATABASE INFORMATION

State of New Jersey
MAIL CODE 501-04
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF PARKS & FORESTRY
NEW JERSEY FOREST SERVICE
OFFICE OF NATURAL LANDS MANAGEMENT
P.O. BOX 420
TRENTON, NJ 08625-0420
Tel. (609) 984-1339 Fax (609) 984-0427

PHILIP D. MURPHY
Governor

SHEILA Y. OLIVER
Lt. Governor

CATHERINE R. McCABE
Commissioner

July 26, 2019

Michael Rondinelli
O'Brien & Gere
301 East Germantown Pike, 3rd Floor
East Norriton, PA 19401

Re: Former Hess Port Reading Terminal Ecological Evaluation
Port Reading (Woodbridge Township), Middlesex County

Dear Mr. Rondinelli:

Thank you for your data request regarding rare species information for the above referenced project site.

Searches of the Natural Heritage Database and the Landscape Project (Version 3.3) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Natural Heritage Data Request Form into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

We have checked the Landscape Project habitat mapping and the Biotics Database for occurrences of any rare wildlife species or wildlife habitat on the referenced site. The Natural Heritage Database was searched for occurrences of rare plant species or ecological communities that may be on the project site. Please refer to Table 1 (attached) to determine if any rare plant species, ecological communities, or rare wildlife species or wildlife habitat are documented on site. A detailed report is provided for each category coded as ‘Yes’ in Table 1.

We have also checked the Landscape Project habitat mapping and Biotics Database for occurrences of rare wildlife species or wildlife habitat in the immediate vicinity (within ¼ mile) of the referenced site. Additionally, the Natural Heritage Database was checked for occurrences of rare plant species or ecological communities within ¼ mile of the site. Please refer to Table 2 (attached) to determine if any rare plant species, ecological communities, or rare wildlife species or wildlife habitat are documented within the immediate vicinity of the site. Detailed reports are provided for all categories coded as ‘Yes’ in Table 2. These reports may include species that have also been documented on the project site.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State’s best habitats for rare and endangered species and ecological communities. Please refer to Tables 1 and 2 (attached) to determine if any priority sites are located on or in the immediate vicinity of the site.

A list of rare plant species and ecological communities that have been documented from the county (or counties), referenced above, can be downloaded from http://www.state.nj.us/dep/parksandforests/natural/heritage/countylist.html. If suitable habitat is present at the project site, the species in that list have potential to be present.

Status and rank codes used in the tables and lists are defined in EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS, which can be downloaded from http://www.state.nj.us/dep/parksandforests/natural/heritage/nhpcodes_2010.pdf.

Beginning May 9, 2017, the Natural Heritage Program reports for wildlife species will utilize data from Landscape Project Version 3.3. If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive web application at the following URL, https://njdep.maps.arcgis.com/apps/webappviewer/index.html?id=0e6a44098c524ed99bf739953cb4d4c7, or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program at (609) 292-9400.

For additional information regarding any Federally listed plant or animal species, please contact the U.S. Fish & Wildlife Service, New Jersey Field Office at http://www.fws.gov/northeast/njfieldoffice/endangered/consultation.html.

PLEASE SEE 'CAUTIONS AND RESTRICTIONS ON NHP DATA', which can be downloaded from http://www.state.nj.us/dep/parksandforests/natural/heritage/newcaution2008.pdf.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Robert J. Cartica
Administrator

c: NHP File No. 19-4007452-17173

Mail Code 501-04
Department of Environmental Protection
New Jersey Forest Service
Office of Natural Lands Management
P.O. Box 420 Trenton, New Jersey 08625-0420
Tel. (609) 984-1339 Fax. (609) 984-1427

Invoice

Date	Invoice #
7/26/2019	17173

Bill to:
O'Brien & Gere
301 East Germantown Pike, 3rd Floor
East Norriton, PA 19401

Make check payable to:
DEP - Office of Natural Lands Management
And forward with a copy of this statement to:
Mail Code 501-04
Office of Natural Lands Management
P.O. Box 420 Trenton, New Jersey 08625-0420

Quantity (hrs.)	Description	Rate (per hr.)	Amount
1	Natural Heritage Database search for locational information of rare species and ecological communities. Project: 19-4007452-17173	$ 70.00	$ 70.00
Michael Rondinelli Project Name: Former Hess Port Reading Terminal Ecological Evaluation		**Total**	$ 70.00

Table 1: On Site Data Request Search Results (6 Possible Reports)

Report Name	Included	Number of Pages
1. Possibly on Project Site Based on Search of Natural Heritage Database: Rare Plant Species and Ecological Communities Currently Recorded in the New Jersey Natural Heritage Database	No	0 pages included
2. Natural Heritage Priority Sites On Site	No	0 pages included
3. Rare Wildlife Species or Wildlife Habitat on the Project Site Based on Search of Landscape Project 3.3 Species Based Patches	Yes	1 page(s) included
4. Vernal Pool Habitat on the Project Site Based on Search of Landscape Project 3.3	No	0 pages included
5. Rare Wildlife Species or Wildlife Habitat on the Project Site Based on Search of Landscape Project 3.3 Stream Habitat File	No	0 pages included
6. Other Animal Species On the Project Site Based on Additional Species Tracked by Endangered and Nongame Species Program	No	0 pages included

Rare Wildlife Species or Wildlife Habitat on the Project Site Based on Search of Landscape Project 3.3 Species Based Patches

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
Aves								
	Black-crowned Night-heron	Nycticorax nycticorax	Foraging	3	NA	State Threatened	G5	S2B,S3N
	Cattle Egret	Bubulcus ibis	Foraging	3	NA	State Threatened	G5	S2B,S3N
	Glossy Ibis	Plegadis falcinellus	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Little Blue Heron	Egretta caerulea	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Osprey	Pandion haliaetus	Foraging	3	NA	State Threatened	G5	S2B,S4N
	Peregrine Falcon	Falco peregrinus	Urban Nest	4	NA	State Endangered	G4	S1B,S3N
	Snowy Egret	Egretta thula	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Tricolored Heron	Egretta tricolor	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Yellow-crowned Night-heron	Nyctanassa violacea	Foraging	3	NA	State Threatened	G5	S2B,S2N
Osteichthyes								
	Shortnose Sturgeon	Acipenser brevirostrum	Migration Corridor - Adult Sighting	5	Federally Listed Endangered	State Endangered	G3	S1

Table 2: Vicinity Data Request Search Results (6 possible reports)

Report Name	Included	Number of Pages
1. Immediate Vicinity of the Project Site Based on Search of Natural Heritage Database: Rare Plant Species and Ecological Communities Currently Recorded in the New Jersey Natural Heritage Database	No	0 pages included
2. Natural Heritage Priority Sites within the Immediate Vicinity	No	0 pages included
3. Rare Wildlife Species or Wildlife Habitat Within the Immediate Vicinity of the Project Site Based on Search of Landscape Project 3.3 Species Based Patches	Yes	1 page(s) included
4. Vernal Pool Habitat In the Immediate Vicinity of Project Site Based on Search of Landscape Project 3.3	No	0 pages included
5. Rare Wildlife Species or Wildlife Habitat In the Immediate Vicinity of the Project Site Based on Search of Landscape Project 3.3 Stream Habitat File	No	0 pages included
6. Other Animal Species In the Immediate Vicinity of the Project Site Based on Additional Species Tracked by Endangered and Nongame Species Program	No	0 pages included

Rare Wildlife Species or Wildlife Habitat Within the Immediate Vicinity of the Project Site Based on Search of Landscape Project 3.3 Species Based Patches

Class	Common Name	Scientific Name	Feature Type	Rank	Federal Protection Status	State Protection Status	Grank	Srank
Aves								
	Black-crowned Night-heron	Nycticorax nycticorax	Foraging	3	NA	State Threatened	G5	S2B,S3N
	Cattle Egret	Bubulcus ibis	Foraging	3	NA	State Threatened	G5	S2B,S3N
	Glossy Ibis	Plegadis falcinellus	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Little Blue Heron	Egretta caerulea	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Osprey	Pandion haliaetus	Foraging	3	NA	State Threatened	G5	S2B,S4N
	Peregrine Falcon	Falco peregrinus	Urban Nest	4	NA	State Endangered	G4	S1B,S3N
	Pied-billed Grebe	Podilymbus podiceps	Breeding Sighting-Confirmed	4	NA	State Endangered	G5	S1B,S3N
	Snowy Egret	Egretta thula	Foraging	2	NA	Special Concern	G5	S3B,S4N
	Tricolored Heron	Egretta tricolor	Foraging	2	NA	Special Concern	G5	S3B,S3N
	Yellow-crowned Night-heron	Nyctanassa violacea	Foraging	3	NA	State Threatened	G5	S2B,S2N
Osteichthyes								
	Shortnose Sturgeon	Acipenser brevirostrum	Migration Corridor - Adult Sighting	5	Federally Listed Endangered	State Endangered	G3	S1